POWER PLANT ENGINEERING

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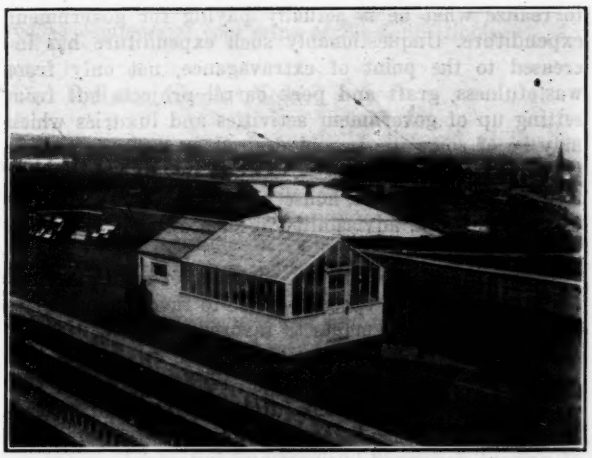


Violet's Pent House

VIOLET! "What Violet," you ask?

Why Ultra Violet of course. For what other Violet do you suppose the research engineers of the General Electric Research Laboratory would be erecting pent houses? These research boys we want you to know are not in the least fickle, furthermore they are very much interested in Violet. True, just at present they are playing around with Lilly and Rose and they even fall for Daisy occasionally but that's nothing to worry about; indeed, that's why they built this pent house for Violet.

Now, that we have managed to get some sex appeal into this article, we can tell you what it is all about. It's this way: For some time the research men at Schenectady have been investigating the influence of electromagnetic radiation upon living things. In agriculture, electricity thus far has found its chief use in pumping water and driving implements. In some instances, ultra violet lamps have increased egg production and the growth of healthy chicks but only recently have the physicist and agriculturist joined hands in seeking to promote plant growth. It is to this end that this greenhouse has been built on top of the General Electric Research Laboratory at Schenectady. One end of the house is built of solid wood so that all lighting is artificial. Here the relative effectiveness of different parts of the spectrum, visible, ultra violet and infra-red can be studied. Electric heating for both air and soil provides constant predetermined temperatures. Electric energy under proper control may usefully determine the date of flowering.

All this is in line with opinions expressed at the N.E.L.A. Convention held recently. As reported on page 540 the idea that research should continue was expressed by many speakers, one indeed referred to research as the "White hope" of the electrical industry.

WITH THE EDITORS

Taxes and Costs

CONCEALED TAXES are the desire of the politician and bureaucrat so that the individual may fail to realize what he is actually paying for government expenditure. Unquestionably such expenditure has increased to the point of extravagance, not only from wastefulness, graft and pork barrel projects but from setting up of government activities and luxuries which may be of some use to and desired by some but which we cannot afford to support. Any of us might be moved to give our daughter a house when she marries but few can afford it and advisability of such an act is doubtful in any case.

Government expenditure, whether for salaries of unnecessary employes, special service to favored industries or unwarranted payments to favored classes of persons *must* be paid for by taxes. There is no other way. We need to be made conscious of and reminded of that fact continuously. That expenditure and the resulting taxation have become so excessive is one of the major causes of present depressed business and industrial conditions.

Direct taxes on real and personal property, income taxes proportioned on true ability to pay not on exemption of the greatest number of voters, stamp taxes and taxes on all sorts of luxury goods whether high or low in value are well calculated for this purpose. The man who owns no real estate or personal property, whose income is exempt and who buys no taxed luxuries often feels that government is costing him nothing, so why worry. He needs to have some reminder such as itemized bills to show: Rent $40, taxes $10; suit $20, tax $5; gas $3, tax $0.75. In the new billing for electric current, the tax, which will unquestionably be paid by the user, should be shown as an added cost, in the same way that the gasoline tax is by filling stations and the admissions tax on amusement tickets.

The oftener and more vigorously each individual is reminded of what he is paying for extravagant government, the better. The more tax conscious we become, the sooner we shall move to secure reduction of such expenditure and that reduction must be achieved to bring our municipalities, states and federal organization back to solvency and to put industry in position so that it can carry on to overcome unemployment and show a profit.

There should be no further tax concealment. Tax costs to all should be brought into the open in every possible way so that they will show, so far as possible, in every expenditure and payment.

New Study of Power Supply Is in Order

ECONOMIC STRESS frequently compels consideration of ideas which have, under other circumstances, been rejected as undesirable. At the present time managers of buildings and industrial institutions find themselves required to reduce expenses and many of them are studying what possibilities lie in changes that can be made in supplying the heat and power loads.

In the large cities of the country few of the office buildings constructed since 1920 have installed their own power generating equipment, preferring rather to have this supplied from the central station system since financial backers demanded a showing of 20 to 25 and, in some cases, even 30 per cent return on their investments.

Now, however, these same financiers would be glad to get considerably less for their idle money, with the result that many buildings are actively considering what changes can be made in their power equipment to make a saving in the services rendered.

Good engineering is good finance. Any concern shows good judgment when it invests its capital in legitimate enterprises that bring the greatest returns. So we continually encounter like conditions that dictate entirely different engineering solutions as the most economical to the investor. What may have been the best plan in 1925 to 1930 may fall into second or third place at the present time due, perhaps, entirely to the market the financier is able to find for his money.

Through many sources, it is learned that engineers in prominent building plants have been directed to make studies of their present costs and estimates of costs with various proposed changes in equipment and practice. The indications are that very careful comparisons will be made between the costs of purchased and generated power, between purchased and generated steam, and between steam and Diesel engines as prime movers and various combinations of services which can be worked out.

That Diesel engine competition is recognized by the utility interests as a serious problem is evidenced by the following paragraph from a paper read at the National Electric Light Assn. meeting at Atlantic City by Arthur A. Silver of Electric Bond & Share Co.:

"A keen competitor of central station industrial power is the Diesel engine, under the very low present prices for engine fuel. Diesel engine designers have been alert to their opportunities—much more so, I believe, than the engineers of our industry generally realize. The last few years especially have brought a marked improvement in materials and design, with greater reliability in operation, higher efficiency, higher speeds and lighter weights. Approximately, there has been a fifty per cent reduction in price per horsepower, reductions in weight and volume per horsepower reaching ninety per cent and large savings in maintenance cost and operating attention. All this has meant the installation of a large number of Diesel engines for small and moderate sized industrial work and for municipal plants—the engine manufacturers selling their equipment on easy payment terms."

This entire problem is one which must be worked out in each individual plant; no strict general boundary lines of application have or can be drawn but changing economic conditions and recently improved power generating equipment have opened this problem for a new solution in a large number of the plants of the country.

Suggestions for Profitable Reading

Trained Ice Plants

One does not ordinarly expect an ice plant to behave like a trained dog, roll over, lie down, get up or play dead, indeed, even the thought of such a thing is absurd. Yet a Virginia company has built automatic ice plants which do almost as well. As described elsewhere in this issue, the equipment starts, stops, changes automatically with the load and does a lot of other things besides. About the only thing they haven't been able to do is to train the ice to jump from the cans to the delivery platform or into the trucks. They might even have attempted that, but they have to have a man there to collect the money anyway and he gets relaxation from pulling the ice. And having a cash register temperaament rather than an ice-man outlook he pulls the whole tank at once! Ice men have always predicted that if this were done there would be rumblings in the heavens, the ground would open up and swallow the whole shebang with one great cosmic gulp—but, strange to relate, the company is still in business.

Coal Tests Are Meaningless!

Now that coffee and cigarettes have been purified by the radio advertising process and all the harmful acrids removed and converted into sheep dip, it is time to look into other things to see what can be found—coal, for instance. Up to now, about all that we have required of coal was that it be black and that a certain amount of what we paid for burned. Few of us—that is, as individuals—ever inquired as to whether the coal was fresh or not.

Now this is all wrong. Coal, Mr. Whittier tells us, in an article in this issue, should be fresh. It should go at one movement only, from the railroad car to the bin feeding the furnace, whether for power plants, locomotives, public utility plants or the heating plant for households. Hereafter, when we buy coal it will be well to examine each piece to see whether it has been properly dated and that it is not too old, for old coal, we are told, lacks vitality or therms or what-have-you.

But all joking aside, this question of fresh coal is really important. Coal exposed to the atmosphere does deteriorate and unless the interval between the time of mining and delivery is reasonably short, considerable of its heat value will have been lost. Because of this Mr. Whittier recommends that coal be purchased and specified on a therm basis rather than on a tonnage basis.

To do this, however, requires proper sampling and this is something we lack today. Mr. Whittier proposes having samples taken at the coal tipple—truly representative samples being taken automatically by a disinterested laboratory which would furnish a certificate to the user, telling him just what he bought. All this sounds complicated but the arrangement is extremely practical—you would buy not a ton of coal but a million therms. Read the article; as large users of coal, power plant men should be interested in this plan which is not only logical but what is more important can be translated into terms of dollars and cents, Mr. Whittier by the way, "knows his coal." Not only is he a specialist in the valuation of coal and other mining properties but as chief engineer and assistant general manager of the Ziegler Coal Co., he developed the world's record commercial coal mine at Ziegler, Illinois.

The Reheat Cycle Again

Now that we have successfully disposed of the ice and coal situations let us take up the re-heat cycle again. Last issue, you recall, we discussed the essential features of re-heat, as applied in practice today. It seems, however, that this question of re-heat is still a moot point. Everybody, it appears, is not agreed that the re-heat cycle is here to stay as we intimated last issue. Some say the re-heat cycle is going out and others say it is just coming out. Well, one guess is as good as another—anyway it was Mark Twain, we believe, who said "It is a difference of opinion that makes horse races."

The question of the re-heat cycle, however, is an important one to turbine builders, for they must supply turbines for whatever conditions are specified. Reheat involves fewer difficulties because the initial temperature and final moisture content are not so extreme. "Westinghouse" feels, however, that the re-heat cycle is slipping in popularity and insists that they must be able to build turbines for any specified conditions. Some of the vital problems involved in this question are discussed by Mr. Soderberg in the article on Steam Turbine Design on page 526.

A Fitting Question

In the selection of fittings used in various piping systems these days, the characteristics and qualities of the metals used in their construction is a highly important factor. In order to understand the fundamental principles of this phase of piping design it is necessary to know what metals are used and the relative values of each in strength, wear and corrosion resistance as well as in cost. Ordinary cast iron, for instance, which has had no treatment subsequent to being cast into pigs, is weak and porous and is unsuitable for power plant fittings. So it must be remelted in a cupola or air furnace and the amounts of dissolved or combined carbon and free graphite kept under control. Such treatment properly carried out should result in a metal with greater strength and free from shrinkage cracks.

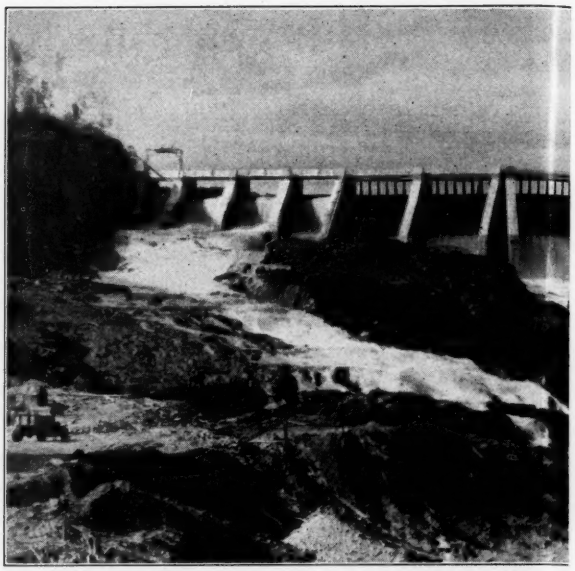
An iron or steel fitting is a rather prosaic thing—off-hand, not particularly intriguing nor worthy of attention. Under 400, 600, 900 or 1400 lb. pressure, however, this fitting becomes a highly important thing and as we delve into the nature and qualities of the material of which it is made, we find a vast amount of knowledge which must be assimilated before we can be sure of what we are talking about. It is for this reason that the article by Henry C. Moffett in this issue is of interest. This is one of a series of articles which Mr. Moffett is presenting on the subject of power plant piping and fittings. Others are to follow.

POWER PLANT ENGINEERING July 1 1932

Wyman Dam Development

New Hydro-electric Power Development on the Kennebec River Adds 68,000 hp. to System of the Central Maine Power Co.

By H. K. FAIRBANKS
New England Public Service Co.



ABOUT TWO MILES ABOVE Bingham, Maine, on the Kennebec River, the Central Maine Power Co. has recently completed construction of a new hydro-electric generating station which makes available to the company's power users an additional 68,000 hp. of hydro-electric energy. This power is developed in two units of 34,000 hp. each, operating under a net head of 135 ft. This development is known as the Wyman Dam Development, in honor of the company's president, Walter Scott Wyman.

Previous to this development, the company's generating system was made up of 24 hydro and 2 steam electric stations, with a combined capacity of 100,365 hp. In 1930 the system output was 292,300,000 kw. hr. With its total installation of 102,000 hp., Wyman Station when completely developed is expected to turn out 280,000,000 kw. hr. in a year of normal run-off. This one station, thus, will just about equal the previous total system generating capacity and output.

The drainage area above Wyman Dam is 2660 sq. miles of forest land dotted with lakes and ponds, the largest of which is Moosehead Lake. The total usable storage above and exclusive of Wyman Lake is 34 billion cu. ft. Wyman Lake has a total volume of 8½ billion cu. ft. of which 2½ to 3 billions are usable.

Though the great number of bodies of water in the drainage basin serve to smooth out the peaks of flood flows, the example of the 1927 flood in Vermont placed a premium on conservatism in spillway design. So, despite the fact that the greatest flood on record at the site of the dam was about 65,000 c. f. s. it was deemed advisable, in view of the dam's geographical location, its long earth section, and the great volume of water impounded by it, to provide a spillway discharge capacity of 246,000 c. f. s. with still a safe freeboard on the earth section.

The general plan of the project is shown in Fig. 1. The power plant is located on a line with what was the recent west shore of the river. From the powerhouse to the west abutment lies the spillway, while immediately adjacent, on the east side is an immense retaining wall which terminates the earth fill section of the dam. The total crest length is slightly over 8000 ft. and the retaining wall is one of the largest ever used in hydro-electric construction. Its total length is 975 ft., its maximum height 165 ft. The earth fill dam extends from the retaining wall adjacent to the power plant, 2460 ft. east to the foot of Baker Mountain, and contains 2,500,000 cu. yd. of material.

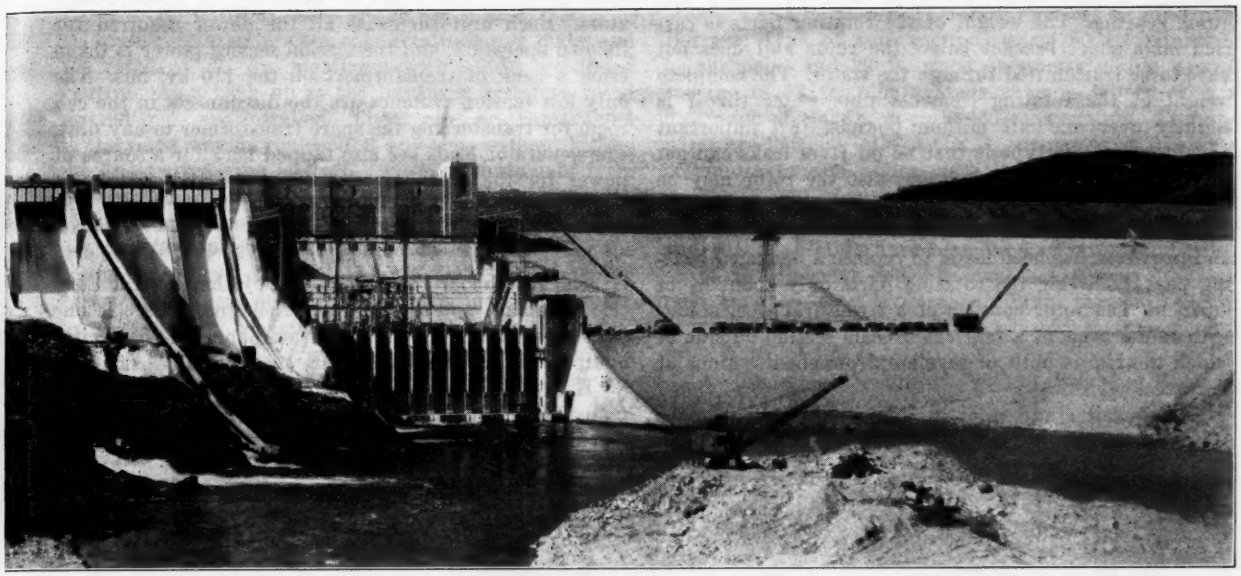
Power House and Intake

In design, the powerhouse is somewhat out of the ordinary. A portion of the superstructure has been eliminated and instead, a concrete deck covers the entire area at elevation 395 ft. Over this is placed a waterproofing membrane on top of which is poured a reinforced concrete wearing slab. A removable glass hatch, octagonal in shape and providing a clear opening of 21 ft. 6 in. is located over each generator. In addition, a service hatch 10 ft. square is provided.

A two leg outdoor gantry crane with a span of 49 ft. 7 in. travels the length of the powerhouse and serves all the hatches and the erection space on the roof. The railroad and roadway are brought on the roof under the crane so that all equipment and material can be unloaded from cars or trucks and set in place. The crane is all electric with two trolleys, each of 62½ tons capacity.

The control room extends across the south face of the building and is separated from the generator room by a double wall 24 in. thick. The main and relay switchboards are mounted flush on the control room wall, with access to the rear of the panels from the generator room side.

The generator room is 33 ft. wide by 155 ft. long. In it are located only the generator units. A small service crane of 16,000 lb. capacity runs the length of the room and is capable of handling all small parts of the units. With the crane, it is possible to do practically all repair work on the units without having the hatches uncovered.



Hydraulic Turbines

Both turbines are Allis-Chalmers, vertical shaft, Francis type machines, set in steel scrolls. They are rated at 34,000 hp. each, under a net head of 135 ft. and at 138.5 r.p.m. The guide bearing is babbitted and oil lubricated. Normally the oil is supplied by a gear driven pump, but a motor driven pump automatically furnishes oil while starting up, and in case of a failure to the main pump. Removable wearing rings are provided on the runner and portions of the cover rings which are immediately adjacent to it.

The governors are also Allis Chalmers make. They are the oil pressure actuator type and are arranged for starting or stopping the units from the switchboard as well as from the governor stand. The fly balls are motor driven. The unit system of pump, pressure and sump tanks is used with cross connection between units to permit any one to be closed if its oil system should fail. All of the governor equipment is located in the basement away from cold air.

An interesting feature of the generator units is that the shaft is of one piece instead of being split between the generator and wheel as is the usual custom. This is possible on account of the two hook Gantry crane and eliminates certain possible chances of misalignment. The complete shaft was furnished by the Allis Chalmers Co.

Drainage of the scroll cases is accomplished by 24 in. diameter pipes through an unwatering pump. The bottoms of the scrolls are 3 ft. below the normal tailwater level, and provision is made for applying compressed air to hold the water down during inspection and repairs. Stop log guides are provided in the tailrace piers to allow unwatering of the draft tubes. The waterway entrance to each turbine is flaring, with a center dividing pier. Welded trash racks protect each entrance. These are made up of 6 by 5/8 in. round edge bars, spaced 5 in. on centers. They are made up in panels of 7 ft. 4 in. by 28 ft. 6 in., and are removable.

Each half of each waterway is controlled by a Broome Caterpillar gate, 11 ft. 1 in. wide by 22 ft. high. At a point 22 ft. beyond the gates the passages converge to a circular section 16 ft. diameter. Between this point and the scroll cases, the penstock is uniform in section and steel lined.

The head gates are operated by stationary electric driven cable hoists of 65 tons capacity with remote control from the main switchboard. They are equipped with up-and-down limit switches, and with position indicating lights on the switchboard. They are located in a chamber below the deck level, with removable slabs over each one to permit its removal if such might be necessary. By locating the hoists inside, the entire mechanism is protected from the weather and maintenance expense thereby reduced.

Generators

Directly connected to the shaft of each turbine is a General Electric generator rated at 24,000 kw., 26,667 kv-a., 0.9 p.f., 13,800 v., 3 phase, 60 cycles. They are the umbrella type with G. E. compressed spring thrust

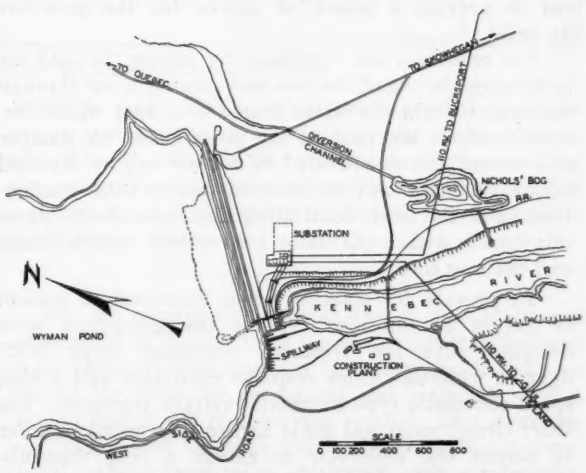


FIG. 1. PLAN OF THE WYMAN HYDRO-ELECTRIC DEVELOPMENT

The dam is built of earth and concrete. It has a total crest length of slightly over 3000 ft.

bearings located below the rotor and have only one guide bearing. The weight of the rotating parts is carried on a short bracket below the rotor and does not have to be transmitted through the stator. The complete weight of the rotating elements plus water thrust is slightly over one-half million pounds. An important advantage in this type is that no oil from leaks can get to the rotor or stator windings; also the rotor may be removed allowing access to the windings without disturbing the thrust bearing. There is ample space available and provision has been made to replace a damaged bearing part by lifting the rotating parts only about ¾ of an inch. The rotor consists of a structural steel spider with radial arms of a fabricated beam section outside of which the rim is built of segmental punched sections of thin steel plates.

Main exciter and pilot exciters are installed at the top of the machine on an extension to the main shaft. The pilot exciter armature is tapped and leads brought out to provide a source of power for the governor fly balls.

The machines are ventilated by taking the cold air in through the top of the case and passing it out through the space within the stator frame to a duct which discharges above the roof of the powerhouse. A damper and second exit is provided so hot air can be diverted to the basement and recirculated during cold weather. Instead of the usual ventilating duct around the stator this duct is within the stator between the outside frame and the iron core.

To provide for stability when connected to present or future transmission systems the generators were designed with low transient reactance, large WR^2, damper windings, quick response excitation and a high speed rheostatic type automatic voltage regulator. The short circuit ratio was made higher than usual in order to permit one generator to charge a long transmission line.

Both ends of each phase are brought out for differential protection and the neutral of each machine to solid ground. There are no auxiliary or house generators. Each unit furnishes all the power required for its own operation, and the station service power is taken from a bank of transformers on the 110 kv. bus. The only low tension switches are the disconnects in the cell room for transferring the spare transformer to any unit. The generator leads are also tapped here for a source of power for the unit governor oil pump and other unit auxiliaries.

Transformers and Switching Equipment

The switchboard was furnished by the General Electric Company and is of Ebony Asbestos. There is one panel for each unit with a separate panel for the exciter equipment. All instruments are by General Electric.

Each unit has its own bank of three single phase transformers and there is one spare transformer for the station. They are Westinghouse units rated at 8889 kv-a. each 13.2 kv. to 115 kv. with taps. On account of the small space available for them they were made of the forced oil cooled type. The hot oil from the transformers is pumped through Griscom Russel coolers through which water from the pond flows by gravity. It is arranged so there is always a positive pressure of 10 lb., or more of oil to water, thus eliminating all possibility of water getting into the oil. The transformers are connected delta on the low side and star on the high side with the neutral solidly grounded. The single phase 500 kv-a. transformers in the line switching yard step power down from the 110 kv. bus for station service and provision is made to feed the local town of Bingham from these transformers.

Main circuit breakers are Westinghouse deion grid type units each having an interrupting capacity at rated voltage of 1,500,000 kv-a. Each breaker is equipped with bushing type current transformers for relaying and the line breakers have additional current transformers for ammeters. The line breakers also have bushing type potential devices for relaying, synchronizing, potential for voltmeters and powerfactor meters.

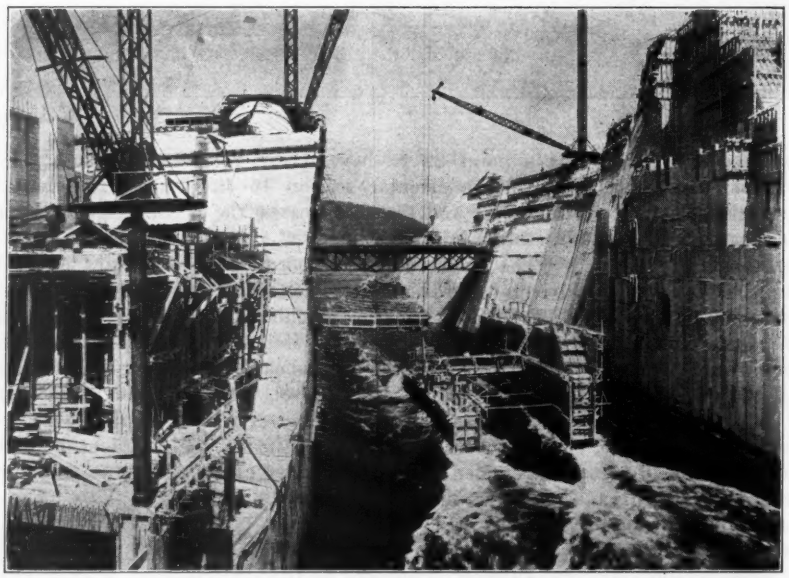


Fig. 2. The First Construction Waterway

Work on the actual construction of the dam began in the late fall of 1928, with an 80 ft. deep open cut through a terrace which lay along the east bank of the river. Simultaneously cofferdams to enclose the retaining wall and power house areas were commenced. By the spring of 1929 this area had been pumped dry and construction started on the retaining wall and power house. By November of that year the river was turned from its old channel into the first construction waterway shown here, and the work of preparing the river bed for the placing of the earth fill had been started.

The opening time at full rated kv-a. from energizing the trip coil to the rupture of the arc is 12 cycles.

Lightning arresters are also Westinghouse make and are rated at 121 kv. maximum with solidly grounded neutral. As a back up to the lightning arresters fused ground gaps are installed. These gaps are constructed so the fuses may be replaced at any time without killing the line or removing any other piece of equipment from service. They are supposed to clear in not over 1½ cycles and the line relays are so adjusted that they will not trip if the ground is cleared in this time. As the transformers are at some distance from the lightning arresters another set of fused gaps is located near the transformers on the main bus. Should these blow frequently, thereby giving evidence of reflected waves of a dangerous magnitude, lightning arresters will be installed at the transformers. As a further protection to the substation apparatus, four ground wires per circuit are carried for three-quarters of a mile from the substation.

A very complete grounding system is installed with all apparatus tied to a common ground bus which has numerous leads extending through the dam to damp earth. Coiled wires buried beneath tower footings and driven grounds are also used all over the substation area. The main ground bus is a series of rings with separate feeders from the different classes of equipment such as transformer neutrals, lightning arresters, etc. The substation and powerhouse grounds are tied together with provision for separating these grounds for testing.

At present there are two circuits from this substation, one 67 mi. long going to Bucksport, the other 72 mi. to Gulf Island Station near Lewiston and there tying in with the 110 kv. system to Farmingdale, Maxcy's and Portland. These lines are of the wood pole H-frame type of construction, using 50 ft. minimum height poles and 29 ft. wood crossarms giving a wire spacing of 14 ft. The average span is 470 ft. with a maximum of 800 ft. on standard construction. The line wires are 266,800 C/M A.C.S.R., strung so as to give a maximum tension under class B loading of 3750 lbs., or 40 per cent of ultimate. Eight standard 10 in. discs are used in suspension and 10 in tension. Locke, Lapp and O.B. insulators have been used. Two ground wires of ⅜ in. diameter crucible steel are strung over the pole caps on steel extensions. Both these wires are grounded at every pole. The right-of-way was cleared for a width of 125 ft.

At Bucksport the line crosses the Penobscot River in a 1680 ft. span. The crossing towers are 205 ft. to the lowest arm and 247 ft. overall, giving a clearance at high tide of 145 ft. The crossing towers are of the suspension type with low dead-end towers. The crossing is designed for ¾ in. radial ice and 11 lb. wind with a liberal safety factor.

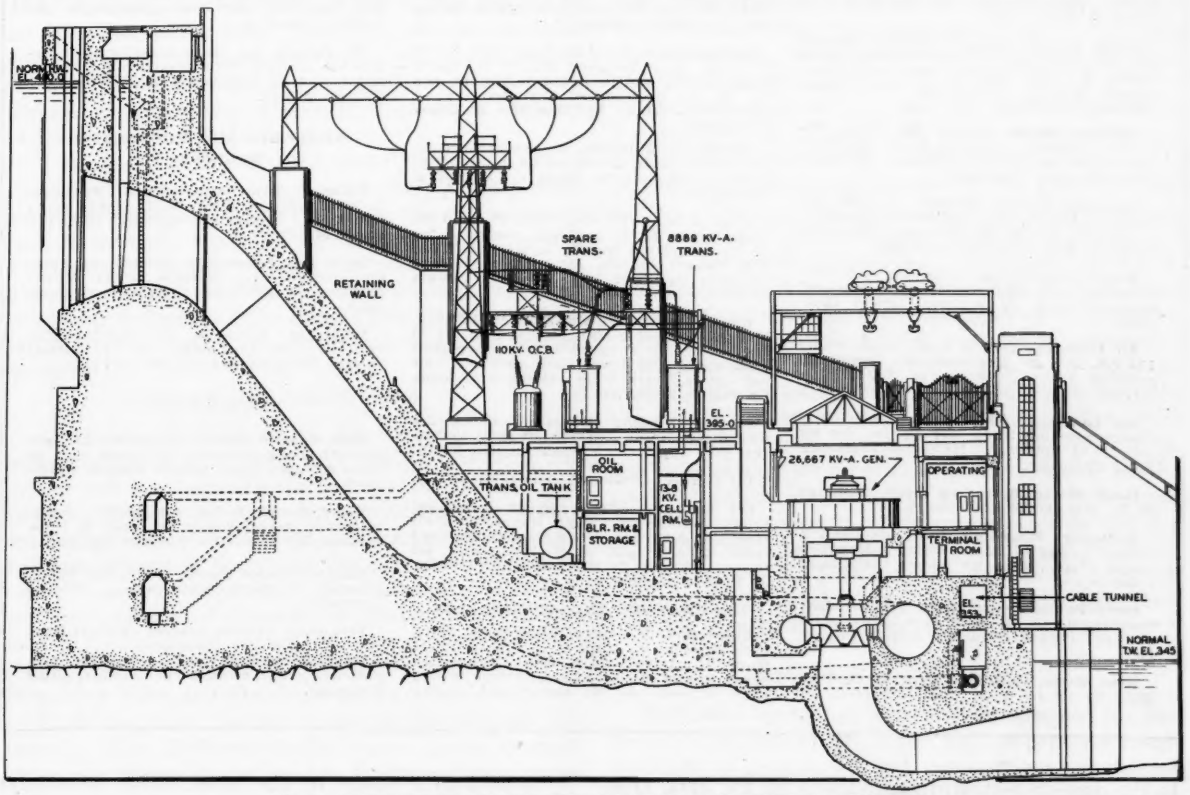


FIG. 3. SECTION THROUGH POWERHOUSE AND TURBINE INTAKE

Conclusion

For the construction of this dam a spur track was constructed to the site from the Maine Central Railroad at Bingham. It was necessary to have access to the west side of the river for equipment and materials, and a steel bridge of 400 ft. span was erected. This structure was designed for Cooper's E40 loading or a 75 ton steam shovel. About three miles of narrow gage construction track were also built.

All concrete was mixed in central plants and hauled

List of Important Equipment Installed at Wyman Station

HYDRAULIC TURBINES AND MECHANICAL EQUIPMENT

Turbines, 2—34,000 hp., operating under a net head of 135 ft., at 138½ r.p.m. Steel volute scroll 16 ft. 0 in. inlet diameter embedded in the substructure concrete. Water capacity 2650 c.f.s., at full gate and guaranteed efficiency. Holyoke test on type model showed 93.7 per cent. Improved elbow draft tubes. Manufactured by Allis-Chalmers Company.

Oil Operated Actuators, 2—type "HR" governors with regulation constant of 7,000,000. Fly balls are motor driven. Arranged for start and stop of unit from switchboard. Closing time full stroke 4 sec. Manufactured by the Allis-Chalmers Company.

Gantry Crane, 1—Two-leg, span 49 ft. 7 in. Lift above rails 27 ft. 0 in. Two trolleys each of 62½ t. capacity. All electric drive. Manufactured by Shepard-Niles Crane & Hoist Corp.

Inside Service Crane, 1—Bridge capacity 8 t., hand propelled. Two Lo-Hed electric hoists of 3 tons capacity each, with hand geared trolleys. Bridge by Conco Engineering Company.

Spillway Bridge Service Jib Crane, 1—of 6 t. capacity. Electric hoist. Mounted on car for travel along bridge. Made by Maine Electric Company.

Passenger-Service Elevator, 1—4,000 lb. capacity, two speed, fully automatic safety controlled. Speeds 200-67 f.p.m. Lift 158 ft. Made by Otis Elevator Company.

Water Chlorinating Outfit for treatment of water for station supply and operators' cottages Made by Wallace-Tiernan Company.

Air Compressor, 8 by 8 in. single stage, 136 c.f. free air displacement. Discharge pressure 125 lb. per sq. in. for station service.

Air Compresor, duplicating above Discharge pressure 30 lb. per sq. in., for air supply to spillway. Made by Ingersoll-Rand Company.

Head Water Recording Gage, 1—range 30 ft., manometer transmitter.

Tailwater Recording Gage duplicating above. Range 15 ft., recording instrument single chart. Made by Brown Instrument Company.

Sump Pump, 1—size 1½ in., vertical shaft centrifugal, 15 ft. head, for powerhouse drainage tunnel. Made by Goulds Pumps, Inc.

Head Gates, 4—Broome type, 11 ft. 1 in. wide by 22 ft. 0 in. high, designed for water head on sill of 60 ft. Smooth sills. Made by Philips & Davies, Inc.

Stationary Cable Hoists for head gates. 4—Electric driven. Capacity 65 t. Hoist speed 2 ft. per min. Equipped with upper and lower limit switches, and position indicating lights on switchboard. Arranged for operation from main switchboard. Made by Philips & Davies, Inc.

Deep Sluice Gates, 2—Broome type, 8 ft. 0 in. wide by 10 ft. 0 in. high, designed for waterhead of 120 ft., over the sill. Smooth sills. Set in line in same 8 ft. 0 in. by 10 ft. 0 in. tunnel. Made by Philips & Davies, Inc.

Stationary Cable Hoists for deep sluice gates. 2—Electric driven. Capacity 45 t. Hoist speed 3 f.p.m. No motors furnished with order. Made by Philips & Davies, Inc.

Rack Rake to be used with Jib Crane. Furnished by Newport News Shipbuilding and Dry Dock Company.

Tainter Gates, 3—20 ft. 0 in. high by 30 ft. 0 in. long designed for 18 ft. water head on sill, and in addition 4000 lb. per lin. ft., ice pressure at any elevation on upper half. Made by Megquier & Jones Company.

Tainter Gate Hoists, 3—Electric driven, stationary cable hoists of 30 t. capacity. Hoist speed 6 f.p.m. Made by Philips & Davies, Inc.

Crest Gate, 1—Broome type, 20 ft. 0 in. high by 20 ft. 0 in. long, designed for 18 ft. waterhead on sill, and in addition, 4000 lb. per lin. ft., ice pressure at any elevation on upper half. Made by Philips & Davies, Inc.

Broome Crest Gate Hoist. Electric driven, stationary, double acting cable hoist of 40 t. capacity. Hoist speed 3 f.p.m. Equipped with upper and lower limit switches, and for remote control from switchboard. Made by Philips & Davies, Inc.

Station Heating Boiler, 1—Coatesville unit fitted for oil burner. Heating system two pipe vapor, with Nash vacuum pump.

Oil Burner, 1—Gilbert & Barker.

Oil Tanks, 1—10,000 gal. steel fuel oil tank. 2—5000 gal. steel transformer oil tank. 1—2500 gal. steel transformer oil tank. 3—1000 gal. steel lubricating oil tanks. All made by the Youngstown Boiler & Tank Company.

GENERATORS AND AUXILIARIES

Generators, 2—General Electric Co. units, each 26,667 kv-a., 13,800 v., .9 P.F., 3 phase, 60 cycles, at 138½ r.p.m. Direct connected, shunt wound exciter, and compound wound pilot exciter. G. E. compressed spring thrust bearing with combined guide bearing, water cooled. Compressed air brakes. Main exciter field rheostat motor operated. Pilot exciter field rheostat hand operated. WR^2 value 15,640,000 sq.-ft.-lb.

Storage Battery, 1—120 cell lead. Made by the Willard Battery Company.

Centrifugal Oil Purifier, 1—De Laval Company No. 600.

TRANSFORMERS

Westinghouse, 7—8889 kv-a., single phase, forced oil cooled, step-up main transformers, 13,200 v. to 115,000 v., with taps on low side. Bushings are interchangeable with O.C.B. bushings.

Westinghouse, 3—500 kv-a., O.I.S.C., single phase, step-down station and local service transformers, 115,000 v. to 11,200 v. with four 2½ per cent taps above the 11,200 v. winding.

Oil Coolers for main transformers, 7—Griscom-Russell, with gravity water circulation and oil circulation by Westco centrifugal pumps.

SWITCHES AND PROTECTIVE EQUIPMENT

Outdoor Type Oil Circuit Breakers. 5—Westinghouse, Type G-222-S, 600 amp., 110,000 v. Rupturing capacity 8000 arc amps. at 110,000 v.

Gang Bus Selector, 4—Electrically operated disconnecting switches, 110 kv. Manufactured by Hi-Voltage Equipment Company.

Lightning Arresters, 2—Westinghouse type SV, 121 kv., max., 110 kv. normal voltage for grounded neutral service.

MISCELLANEOUS

Main Control Board, 1—General Electric, vertical ebony asbestos, 14 panels each in three sections, with General Electric equipment.

Relay Board, 1—General Electric, vertical ebony asbestos 6 panel, each in three sections, with General Electric equipment.

Station Service Board, 1—vertical ebony asbestos, 6 panel, with General Electric equipment.

Frequency Control System, General Electric—Warren type automatic.

Outdoor steel switching structure furnished by Lackawanna Steel Construction Company.

to the dam in bottom dump buckets on flat cars, from which the buckets were swung into place by cranes or derricks. Except for a few hundred tons at the start of the job, all aggregate was obtained at the site. A pit was opened about a mile below the central mixing plant on the west side, where a screening and washing plant was set up. All the aggregate was washed.

A total of 260,000 cu. yd. of concrete was placed in the dam and core wall. In the construction, there were 195,000 cu. yd. of rock excavation and 300,000 cu. yd. of earth excavation. The average rate of placing the earth fill during the job, was about 8000 cu. yd. per 24 hr., with a maximum day of 10,500 cu. yd. The maximum number of men employed at one time was about 2400.

Twelve miles of Federal Aid highway was built on the east side of the lake to replace the old one which was flooded out. Fourteen miles of secondary road were built on the west side.

A hydraulic model of the construction waterways and spillway was built on a scale of 1:144. Coefficients were determined on larger scale models. The capacity of the model was 1.5 c.f.s.

The project was designed, and field engineering handled by the New England Public Service Company and supervision of construction by Morton C. Tuttle Company of Boston.

AT THE plant of the Kay-Bee Co., Morrison, Ill., having two 300-hp. boilers fired with pulverized coal, the breeching slants up to the stack at 45 deg. Uptakes are brought in tangential, one at the bottom, the other at the top of the breeching diameter, producing a centrifugal action which throws the dust particles out against the breeching wall where they are caught by a plate and diverted to a trough running to the lower end of the breeching. Thence they are removed to the ash pile.

Pipe Fittings Used in Power Plants

Consideration Given to the Metals and Alloys Used in the Manufacture of Fittings—Physical and Chemical Characteristics and Fitness for Service. By Henry C. Moffett*

MANY KINDS and forms of fittings are used in the various lines that make up the piping systems in an up-to-date power plant. Each type has its particular function and, while there are several that may be chosen for any one service condition, the choice may depend on several considerations—economy, appearance, locality or the experience of the designer.

In order to understand the underlying principles of this phase of piping design, it is necessary to know what metals are used for fittings and the relative values of each in strength, wear and corrosion resistance, as well as in cost. It is also necessary to know in what forms fittings may be obtained on the market without resorting to special designs and the capabilities of each of these in maintaining tight joints and trouble free lines for any service.

Cast Iron for Fittings

Ordinary cast iron, which has not had any subsequent treatment after being cast into pigs, is weak and porous and is not suitable for power plant fittings. Cast iron for fittings should be of a good quality, with a smooth grain, and should be soft enough to machine without difficulty. Remelting the pigs in a cupola or air furnace is necessary to refine the metal and to control the amounts of dissolved or combined carbon and free graphite. This treatment, properly carried out, should result in a metal with greater strength and free from blow holes and shrinkage cracks.

Light cast-iron castings, those having sections less than ½ in. in thickness, should have a tensile strength of at least 20,000 lb. per sq. in. Heavy castings, whose sections are 2 in. or over, should have a tensile strength of 24,000 lb. per sq. in. Castings between these in section width, should have not less than 21,000 lb. per sq. in. tensile strength. These cast irons should have a sulphur content not to exceed 0.12 per cent. Castings of this material resist corrosion remarkably well and have good wearing qualities. This, together with the fact that cast iron is relatively inexpensive, makes it an ideal metal to use wherever possible.

Metallurgically Improved Cast Irons

Cast iron remelted with scrap steel will have a tensile strength of about 30,000 lb. per sq. in. This resulting metal is still cast iron, although it is offered on the market under various names, such as semi-steel. In no case should fittings, which are really pressure castings, made of this material be used for temperatures above 450 deg. F. It is a valuable metal to use when greater strength is required but it still contains a large percentage of free graphite, which causes the castings to expand beyond a safe point with temperatures above this limit, and is liable to fail in service on account of the weakness of the graphite.

Malleable iron is really cast iron made malleable by a special process. This process forces the graphite content to form in the casting as a very fine powder instead of flakes and, when properly carried out, gives the outer surface of the castings a whitish color, leaving the interior of the castings quite black. This metal is known as black heart malleable iron and it is best suited for the manufacture of malleable pipe fittings, as it is much stronger than cast iron, and is ductile—a quality lacking in cast iron. Malleable fittings are usually annealed in iron oxide, which robs the surface of its free carbon and graphite. Such castings have a close grain structure, and the tensile strength of the metal is increased to 40,000 to 42,000 lb. per sq. in. A good malleable-iron fitting will resist strains set up in pipe lines that would break a cast-iron fitting. Malleable-iron fittings, however, should never be used where the temperature exceeds 450 deg. F., for the same reason that cast-iron fittings are so limited, and that is the high graphite content. Yet, for cold water and oil lines, malleable-iron fittings have been used for pressures as high as 2000 lb. per sq. in.

Fittings of Cast Steel

Cast steel for fittings is principally specified for lines above 250 lb. per sq. in., where the temperature ranges from 450 to 750 deg. F., and such castings are dependable when the metal is sound. Defective steel castings have been the cause of a lot of trouble in the past, but foundry practice has been greatly improved of late years and many of the earlier troubles have been overcome. This is due to the fact that foundries are more closely supervised by experienced men and the metallurgical characteristics of the material are more thoroughly understood.

Prospective purchasers, however, should make sure of the shop practice when specifying materials for important high pressure work. It is quite common to send customers' inspectors to steel foundries to follow carefully the material through and to reject all unsound material, whether due to poor steel, unsatisfactory castings, or improper annealling, as well as to limit the amount of welding permitted for the reclamation of imperfect castings.

Cast steel is made by several processes. The purchaser has his choice and may specify electric steel, or

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steel made by some other method. Steel castings should be carefully heat treated and the buyer should clearly state his preference or refer to the standard specifications of the American Society of Testing Materials in his own specifications.

The standard specifications set down the minimum requirements as to tensile properties of cast steel for high pressure and high temperature fittings, which are as follows:

Tensile strength, lb. per sq. in.	70,000
Yield point, lb. per sq. in.	36,000
Elongation in 2 in., per cent	22
Reduction of area, per cent	30

The above refers only to carbon cast steel for valve bodies, flanges and fittings, for service up to 750 deg. F. Alloy steels have much greater strengths as a rule and some of them are suitable for use in power plant and refinery work at temperatures up to 1100 deg. F.

Electric cast steel has gained in favor in the past few years on account of the uniformity of the products of the electric furnace, the homogeneity of the metal, the finer grain structure and more uniform strengths resulting from the easier control of the temperature in the furnace, and to the fact that the castings are more nearly free from gas inclusions and impurities.

Properly made castings have large shrink heads when cast. These act as reservoirs of molten metal to compensate for the shrinkage of the metal in the body of the casting when passing from the molten to the solid state. Patterns which have been thus correctly made assist in a large degree in producing castings that are free from cavities and pipes.

Some manufacturers offer alloy-steel fittings for high pressure work. Such fittings have greater tensile strengths than plain carbon steel fittings and therefore afford greater factors of safety. They also have much greater resistance to shock and fatigue. As temperatures increase in power plant practice, the use of alloy-steels for fittings will undoubtedly increase.

Forged steel is superior to plain carbon steel on account of the benefits obtained by working. These benefits are closer grain structure, more uniform texture and greater strength. Forged fittings are usually made in the smaller sizes only, and are used in important lines that would be most troublesome. Both flanges and fittings of forged steel are frequently welded to the pipes to prevent leaks, especially on lines which are alternately hot and cold, and lines which are usually left uncovered, such as drip lines and soot blower piping. Flanged fittings of forged steel are sometimes made in several parts, then screwed and welded together.

Use of Alloy Metals

Brass fittings may be obtained on the market, both screwed and flanged. The screwed fittings used in power plant work are specified as "Iron Pipe Size," to distinguish them from the brass fittings used in plumbing work, and are made from cast or malleable iron fitting patterns, threaded to the American Standard.

Brass and bronze, as well as monel metal and other nickel alloys, are used for parts of unions, especially for facing materials. When in contact with steel faces, these metals make tight joints under most conditions. Such joints may also be easily broken as the faces will not corrode and grow together. Monel metal and steel have coefficients of expansion which are approximately the same, and therefore the metals expand at about the same rate. For this reason, unions with one face of monel and one of steel remain tight even at elevated temperatures.

Kinds of Fittings

Fittings may be classified under six general headings:

A.—As to standard pressure rating and temperature.
B.—As to the kind of materials used in making.
C.—As to the end connections and machine work finish.
D.—As to shape.
E.—As to the service intended.
F.—As to the protective coating on the outside.

Many of the standard pressure ratings and temperature allowances are covered by the American Standards, as listed below:

B-16b2-1931	Cast-iron Pipe Flanges and Flanged Fittings, for Maximum WSP of 25 lb.
B-16a -1928	Cast-Iron Pipe Flanges and Flanged Fittings for Maximum WSP of 125 lb.
B-16b -1928	Cast-Iron Pipe Flanges and Flanged Fittings, for Maximum WSP of 250 lb.
B-16b1-1931	Cast-Iron Pipe Flanges and Flanged Fittings for 800 lb. Hydraulic Pressure.
B-16d -1927	Cast-Iron Screwed Fittings for Maximum WSP of 125 and 250 lb.
B-16c -1927	Malleable Iron Screwed Fittings for Maximum of 150 lb.
B-16e -1927	Steel Pipe Flanges and Flanged Fittings for Maximum WSP of 250, 400, 600, 900 and 1350 lb.

Others, not covered by the accepted standards, are used by manufacturers and acknowledged by all reputable ones, have been developed by them and offered to the trade. Many such standards have been in use for years with little or no change. The American Waterworks Association and the American Gas Association also have standards for fittings intended for use in underground water mains and in gas piping practice.

End connection of a fitting may be threaded, flanged, beveled for welding or shaped to form a bell or spigot. If a screwed fitting is ordered, other than the standard cast-iron or malleable-iron variety, the kind of threads and the number of threads per inch should be stated, or a reference to some standard tapping be made.

Flanged fittings may be faced and drilled or not, as called for. If back facing is required, in order to secure an even bearing surface for the bolt nuts, it should be mentioned on the order. Special facings should be covered by prints of the details required, and the finish of the gasket bearing surface should not be left out, as otherwise a rough machine finish may be considered all that is necessary by the manufacturer. Faces may be ground or polished, or given a concentric or spiral V-cut, according to the wishes of the designer.

The shape of a fitting may be standard, such as the elbow, tee, lateral, cross, plug, cap, reducer, etc., or may be a variation of the standards, such as reducing elbows, base tees, and eccentric reducers. Reducing and base fittings have standard dimensions, but usually have to be made special, unless they are designs that are used frequently, and therefore stocked. Manufacturers' stocks and patterns differ in this respect, but lists may

be obtained from them showing the fittings carried in stock, or ones for which patterns are already made.

Special fittings, although using standard dimensions, should never be ordered without an accompanying sketch, for it is practically impossible to describe some fittings, without ambiguity.

Elbows, in many cases, may be short or long radius; tees may be standard or may be sweep tees; base fittings may have round or square bases, and the drilling of the bases may be almost anything. Any of these may be bossed and tapped for drainage, according to the requirements of the case. Hence the shape of the fitting is important, and should be fully described, or drawn up, to prevent errors in its manufacture.

In addition to the pressure rating, kind of material, end connections and the shape of the fittings, it is necessary to state the service for which the fittings are intended. This may be water, gas, oil, steam or air; the fittings may be for drainage or soil pipe service, or may be intended for railings. While the standards for some of these overlap, others do not. Frequently the same kind of fitting may be used for several kinds of service, but not always. The standards may differ only in the thickness of the metal, but more often the entire shape of the fitting is different.

Standards

The American Standards referred to above, are published by the American Standards Association. These have been either finally or tentatively approved by all of the sponsor organizations and are strictly adhered to by all responsible manufacturers.

Each standard gives the range of standard sizes, and omits sizes, formerly made, which are not now considered standard. Each also gives the recommended pressure rating, the physical and chemical requirements of the materials to be used, the standard facing, bolt drilling, spot facing and the necessary dimensions for the manufacture of any and all fittings, both straight run and reducing, that might be desired.

When American standards are not available for the particular kind of fitting being considered, manufacturers' standards should be consulted, and all fabricators' handbooks and catalogs closely studied, before a designer attempts to make a special design for any fitting.

Specials

In addition to all the standard fittings and variations of them listed in publications issued by fitting manufacturers, many special fittings are usually required in the construction of a modern power plant. These special fittings may be obtained from any reliable manufacturer, but in every case complete designs should be submitted, as new patterns must be made.

Special fittings are not uncommon, since many additions to old plants require connections to old equipment or piping systems, which were erected before the accepted standards came into general use. Again, in close quarters, especially around turbines and condensers of modern size, specials are used purposely in order to cut down the number of joints. These specials may have one leg of a tee longer or shorter than the standards call for, or may be some queer shape with openings at odd angles, in order that the fitting may fit into some particularly restricted space.

All important fittings should be tested before being placed in service. There are many ways that manufacturers and others do this testing. One of the newest and surest ways to detect flaws is by the use of the X-ray. Many of the larger concerns are equipped to test by this method or have neighboring concerns who make a specialty of this kind of work.

Pressure testing, using water at once and one-half or twice the pressure to be used in service is of great help, but does not show the effects of elevated temperatures which may occur in actual use. Testing by the use of high-pressure steam is sometimes resorted to, but is impractical in most shops.

In closing, a word of caution may not be out of order—do not be too quick to judge a fitting or casting by its outside appearance. Get all the facts available about the physical and chemical properties of the metal used; inspect the test reports and, if in doubt, play safe and have the item tested for your own protection.

Savings Through Standardization of Purchases

ECONOMIES resulting from the standardization of purchases are listed in a report on the standardization work of the Detroit Edison Co. published in the monthly bulletin of the American Standards Association. The author, F. M. Price, tells how the company has applied standardization to the purchase of over 65,000 different types of materials and equipment at an annual cost of more than $20,000,000.

Following are the gains through standardization: Reduction of excessive stocks of materials and replacement parts; reduction of the number of items carried in stock; elimination of slow moving and stagnant stock items; minimizing private stocks of material and supplies; reduction and prevention of duplication of stock items; reduction of number of different sizes and varieties of each item; fewer specially designed items; orderly introduction of new material; orderly retirement of obsolete material; elimination of items too good for the job; less lost motion in purchasing and requisitioning; fewer incorrect shipments of goods; less time lost in shipment; fewer purchase orders; well regulated buying of definite quantities of stock items at periodic intervals; more general quantity buying; greater latitude afforded buyer because of a wider use of the proper terminology for items; the buyer is enabled to know exactly what he is buying; establishment of standard nomenclature and adequate specifications; fewer discrepancies in inventories; correct descriptions on purchase orders; real inspection of materials is made possible; reduction of bookkeeping; establishment of a classification of materials and equipment.

Numerous specific examples of savings are cited. The number of different types and sizes of outlet boxes was reduced from 41 to 6, a curtailment of 85 per cent. The corresponding increase in the quantity of each type of box used resulted in a net saving of 25 per cent over the previous cost of the outlet boxes. The number of different types and sizes of steel pull boxes used for various wiring jobs throughout the company was reduced from 2230 to 4. Standardization of trolley cord permitted the company to save $1000 per year on this one item alone. A saving in cost of nearly 50 per cent was made by standardizing fire extinguisher liquid.

POWER PLANT ENGINEERING July 1 1932

Problems in Steam Turbine Design

Outline of a Few Problems Confronting the Modern Turbine Designer as Explained to the Engineering Society of Western Pennsylvania. By C. Richard Soderberg*

OUTWARD PROGRESS of steam turbine development during the last 10 yr. has been very remarkable in several respects. The heat consumption has been decreased by the use of higher operating temperatures and pressures and by methods of regenerative heating; the turbine efficiency has been increased by refinements in the design of the steam path and the maximum size of the individual units has been very materially increased. These advances have been paralleled by improvements in reliability and by an equally remarkable reduction in weight and space requirements. Incentive of high operating pressures and temperatures is easily understandable in view of the possibilities for improvements in station performance.

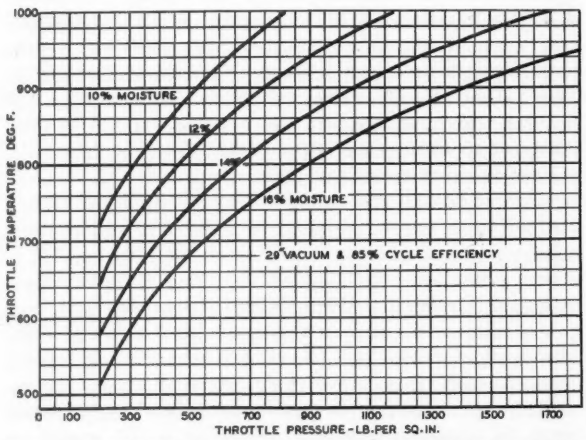


FIG. 1. THROTTLE PRESSURE AND TEMPERATURE AND MOISTURE CONDITIONS AT EXHAUST FOR A MODERN TURBINE

The problem is affected in a fundamental way when the practicability of reheat is admitted. There is, then, no definite limit to the operating pressures unless the temperature is carried beyond certain limits. It is difficult to draw definite conclusions with regard to the practicability of reheat but there seems to be discernable a trend away from this complication in plant layout and initial expense. To the turbine builder as such, reheating naturally offers a somewhat simplified problem, since excessively high operating temperatures are generally not used in connection with reheating.

When reheating is not employed, the problem enters a stage where the turbine builder is vitally concerned. The moisture content of the steam in the exhaust to the condenser is now the limiting feature, requiring for each inlet pressure and each cycle of regenerative feed heating a certain minimum inlet temperature. Figure 1 shows the relation between inlet pressure, inlet temperature and moisture in the exhaust for typical turbines of modern design for central station application.

*Manager Turbine Apparatus Division, Westinghouse Elec. & Mfg. Co., South Philadelphia, Pa.

High Temperatures

In this connection the present period of the development is an important one. An inlet temperature of 825 deg. F. may now be considered as established and practicable without material increase of maintenance. Figure 1 indicates that, with 12 per cent moisture in the exhaust, which is considered the limiting value for the high peripheral speeds now employed, the inlet pressure cannot materially exceed 1200 lb. per sq. in., even assuming that 1000 deg. F. inlet temperature were practicable.

Regardless of the desire to increase this pressure, there will undoubtedly be a tendency to raise the inlet temperature. The ultimate limit in operating temperature must be associated with the type of turbine involved. In the case of small, high pressure cylinders of tandem compound or cross compound units, it is not improbable that 1000 deg. F. may ultimately become a practical operating temperature.

Maximum output of a condensing turbine is determined chiefly by the last row of blading. The progress towards large size of individual units has thus been a gradual enlargement of the last annulus. This necessitated extensive metallurgical developments to obtain blade materials that would stand the stresses imposed.

Problem of Mechanical Strength

As the temperature increases, the materials undergo more or less far-reaching modifications. The figures of strength generally drop with increasing temperatures; the figures of ductility increase. At 1000 deg. F. practically all of the materials available at present are profoundly modified. Figure 2 shows curves of strength and ductility for stainless steel.

Actual reduction in strength is not the most important change, however. The usual permanence of the elastic properties is destroyed and the materials behave approximately as amorphous materials. This phenomenon of creep is of greater importance than the reduction in strength and must be considered in the dimensioning of high temperature turbine parts. Unfortunately the available knowledge is entirely insufficient to make definite predictions of creep in most cases, nor does it seem likely that exact knowledge will be available very soon.

The Erosion Problem

Another equally serious problem is erosion which is a function of both the degree of moisture and the impinging velocity. Presumably, the size of the drops and the pressure also enter into the phenomenon but the actual relationship is not very well understood as yet. There is no uncertainty about the seriousness of the problem, however, because this erosion is at the present time the chief factor in limiting the peripheral speed and thus the exhaust annulus of large turbines.

It has been given considerable study in the last few

years. The most important methods of approach are: increasing the absolute velocity of the water by reducing the drop size; draining the moisture from the blading; and increasing the erosion resistance of the blading material. No satisfactory method has been found to accomplish the first object but a certain measure of success has been obtained by draining out the precipitated water. A somewhat superficial check of one machine sometime ago indicated that about 25 per cent of the total moisture precipitated in a row may be drained off in this manner.

The most important and most effective aspect of the erosion problem, however, is to make the blading impervious to the bombardment of the water drops. It has now been agreed for sometime that, beyond the use of stainless steel, it is impractical to employ a blade material of sufficient inherent hardness to be impervious to the erosion. This leaves as the only alternative a protective shielding of some kind.

Protective Shielding

Chromium plating in thicknesses up to 0.005 in. has been used for sometime with a certain measure of success. It is a very expensive method, however, and the question of renewing the coating is troublesome. In addition, there have been advanced arguments about embrittling actions of these extremely heavy platings. This is not yet fully explored but recent tests indicate that a certain embrittling may occur. Nitriding the blades on the inlet edges has also been used with satisfactory results as far as erosion protection is concerned. Nitriding the thin edges leaves them very brittle, however, and the method has not come into general use. Nitriding the thick inlet edges only is a possibility and when applied in this manner the method has attractive possibilities.

Separate shielding strips applied to the blades by welding or soldering is now regarded as the most favorable solution. A tremendous variety of protective shieldings has been tried, of which may be mentioned tungsten,

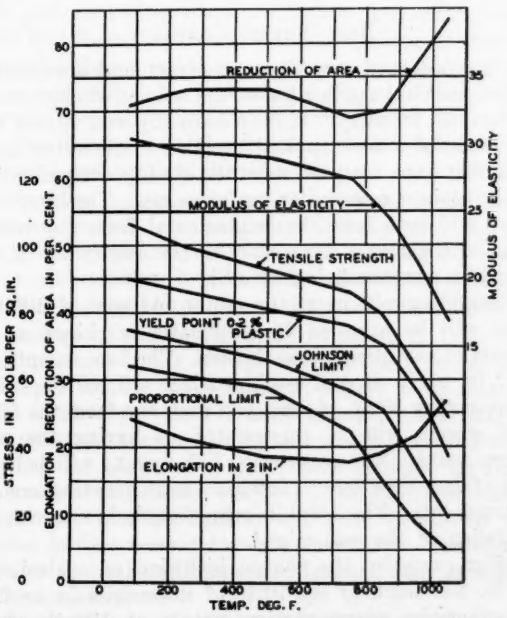


FIG. 2. PHYSICAL PROPERTIES OF STAINLESS STEEL

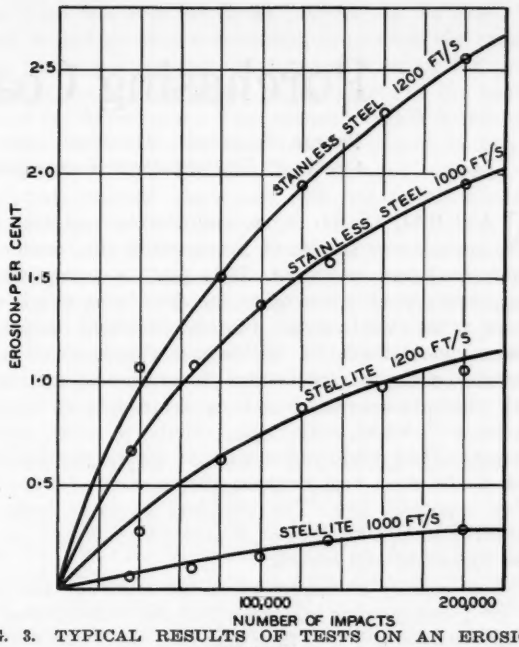


FIG. 3. TYPICAL RESULTS OF TESTS ON AN EROSION TESTER

tantalum, stellite, contracide, resistal and numerous others. Tantalum and stellite are the most promising, particularly the latter, having given excellent results in service on some large units. With this method of erosion protection, blades with tip speeds exceeding 1200 ft. per sec. will now give the same service as ordinary stainless steel blades for tip speeds of the order of 900 ft. per sec.

A great deal of valuable operating experience is now being accumulated on the subject of erosion. One of the turbines of the Duquesne Light Co., for example, is equipped with some 30 different kinds of shielding materials. The problem of erosion protection received its most important impetus by the development of a rational erosion tester. The Westinghouse Co. has now had such a tester in operation for sometime and a large volume of valuable results has been obtained. The curves on Fig. 3 show comparative results for stainless steel and stellite for impinging speeds of 1000 ft. per sec. and 1200 ft. per sec. The evidence in favor of stellite shielding is very pronounced. Of particular interest is the fact that this erosion tester has so far confirmed in every detail the evidence gathered from machines in actual operation.

Strength at High Temperatures of Cast and a Forged Steel as used for Turbine Construction, by H. J. Tapsell and A. E. Johnson. Published as Special Report No. 17 of the Department of Scientific Industrial Research. For sale by The British Library of Information, 270 Madison Ave., New York City.

This is a detailed report of the investigations undertaken at the National Physical Laboratory to determine the behavior of metals at high temperatures. The report contains the results of short-time tensile tests and creep tests carried out on a 0.30 per cent carbon cast steel and a 0.39 per cent carbon forged steel over a temperature range of 750 to 1200 F. Tests show that the cast steel possessed limiting creep stress considerably lower than the forged steel.

POWER PLANT ENGINEERING July 1 1932

Purchasing Coal on a Therm Basis

PROPER SAMPLING METHODS AND CONTRACTS ON A HEATING BASIS ESTABLISHED BY DISINTERESTED LABORATORIES ADVOCATED. BY CHARLES C. WHITTIER*

NATURAL COAL is an engineering material and contains no secrets or peculiarities that cannot be determined and measured. It is just as susceptible to engineering quality control as the alloy in an automobile piston or the steel in a rail. In order to design the proper means and methods for therm coal sampling, we must first gain a closer visualization of the natural coal material which, wherever found, is composed of varying amounts of water, clay, slate, calcite, gypsum, pyrite, marcasite, and often other mineral substances, in addition to the main heat element, the remains of trees and other vegetable life. The chemical engineer looks on natural coal as a mixture of minerals with oxygen, nitrogen, hydrogen and carbon.

Coal is fully as important, if not more so, than ores of other engineering materials that are standardized on quality values and it is time that coal came under scientific control and began to regain some of its lost business. Selling and buying without adequate specifications and with no knowledge of coal other than weight and trade name is strictly a non-scientific procedure. Weight and trade name have no useful heat value. The user wants heat and must know what that costs so that he can choose whether or not to purchase therms from gas, oil or coal. When I buy a ton of coal for $8.00 and a therm of gas at $0.10, I have no means of heat price comparison to determine whether the gas or the coal is the cheaper. I must have the same unit of sale in each fuel. A ton of coal has about 270 therms; this, at $0.03 per therm, is $8.10. When I know that a coal therm is $0.03 and a gas therm $0.10, I have the starting point in making a choice and to buy to my best advantage. The coal seller has the most powerful sales argument that can be presented, a therm of real coal heat for $0.03 against the competitor with a therm of gas heat at $0.10. What more can any director of coal merchandising want than the opportunity to sell coal therms?

This same situation applies to purchasing agents who are buying coal in car or 50,000 t. lots. The owners of corporations buying coal in large lots, as well as the tax-payers on coal for public consumption are entitled to know the therm value of the coal purchased by their agents so that they may determine whether they should continue to buy coal, gas or oil.

Buyers of heat are being educated in therm gas buying and thinking in therms. Under the changed market conditions it is imperative that coal merchandising change to therms to meet the inroads of gas and oil fuels.

SAMPLING NOT SCIENTIFIC

Best sampling procedure that exists in coal today can only be classed as semi-scientific, in that coal is occasionally sampled and paid for by the buyer on his own samples and analyses. In general, sellers have no scientific sampling or chemical analysis, but instead wait for the results of the buyers. If these are not satisfactory a complaint can be lodged which begins the arguments and waste that results from controversies over coal quality. The situation in quality control is in a chaotic condition simply because it is non-scientific.

A sample of coal taken improperly is worthless as a basis for analysis, often being the starting point of arguments and sometimes litigation which results in increased selling costs and loss of business. Samples of coal which are taken from the best lump and analyzed to represent the quality of the entire shipment of coal in bulk are misleading and tend to needless waste.

SCIENTIFIC MERCHANDISING

First step toward a better condition in the coal industry is scientific merchandising which, in turn, depends upon the use of scientific sampling methods and correct chemical analysis for all coal mined and sold. This sampling should be at the point of production as the coal is loaded into the cars. The proposed new therm contract for Illinois and Indiana coals will provide, among other things, detailed specifications, impurity limits, means and methods of sampling, and will provide that the sampling, analyses and inspection shall be under the control and supervision of competent, fully equipped, experienced engineers having no pecuniary interests whatsoever on the side of either the buyer or the seller, but who are strictly on a scientific or professional basis. This contract will also provide that when coal is sampled and analyzed its quality is determined once and for all, thus eliminating the waste of sampling in small lots at many different places and under adverse weather conditions.

NEW THERM CONTRACT

The proposed new therm contract and specification is the practical application of the science of engineering to the coal industry. It is in harmony and agrees with the principles now applied to other engineering materials that have accepted scientific quality determinations as the basis of commodity useful values. The buyer and seller will both have the fundamental facts required to form a contract. This will be the beginning of the scientific merchandising of coal.

Sampling will be at the mines and coal of different sizes will be sampled by automatic machines as the stream of coal passes into the car. The base sample will be 2 lb. per t. of coal combined into a 1,000 lb. sample representing 500 t. of coal, and each car from the 500 t. coal stream will be represented as having the same therm value. The same rule, 2 lb. per t., will hold for lots of less than 500 t. down to and including one car or truck lots. The 1,000 lb. mine sample is a true representation of the coal mined.

For example, the chance inclusion or exclusion of 10 lb. too much or too little of impurities in or from an otherwise representative sample of 100 lb. would

*Consulting Engineer, Robert W. Hunt Co., Chicago, Ill. From a copyrighted address delivered before the Midwest Bituminous Coal Conference, Purdue University. Apr. 15, 1932.

cause the analysis to show an error in ash content and in heat units of say 10 per cent, whereas for a 1,000 lb. sample the effect would be approximately 1 per cent; being the same whether the sample is collected from a 1 t. lot or from a lot consisting of several hundred tons. The samples will be mechanically crushed, mixed and reduced to two 7½ lb. samples ready for delivery to the chemical laboratory for the necessary analysis of ash, sulphur, moisture, carbon, or other elements and the therm value determination.

Laboratory results will be assembled with the car numbers, date and weights and form the therm certificate that is a part of the bill and settlement statement. This therm certificate follows the car that it represents to the destination of the purchaser. When the payment for the therms purchased is made the therm contract for the particular car is completed and the seller has sold and the buyer has bought a definite amount of useful heat.

Introduction of scientific merchandising and of the therm contract into the coal business will permit more successful competition with the scientific merchandisers of gas and oil that are now selling therms. Most gas therms are sold at a price, fixed by law, that is fair and reasonable and permits the seller to receive compensation for the commodity, depreciation and operating expenses, plus a reasonable profit. The therm price is thus fixed in different communities according to conditions and is the price most coal therms must compete with. The market price of the public utility therm in a particular locality and for a particular use is the price-maker and may regulate, to a considerable extent, the price of coal therms, so that they can be sold at a profit.

Rail tariff can be based upon the therm value. The principle of a freight tariff in proportion to the useful value is of long and tried use in freight tariffs, and may be of value to Illinois and Indiana coal. Waste and expensive trouble in selling connected with impurities in coal will be eliminated, as they are taken care of in the mine sample, therm contract and certificate. This will reduce selling costs. Another important benefit from the therm certificate is the furnishing of the fundamental data needed by engineers in designing furnaces best suited to the coal and the reconditioning of obsolete furnace types. A new and efficient furnace art can be developed. The furnace should be designed, operated and serviced for this coal.

Pressure for the elimination of smoke is increasing as gas is coming more and more into use and you may look for regulation prohibiting the burning of coal in many places unless it is burned under better conditions of furnace practice and the smoke practically eliminated.

Storage of coal is important as the U. S. Coal Commission found "that storage costs range from $0.50 to $0.75 per ton for large storages 50,000 t. or more, to $1.00 to $1.50 per ton for small storage, a few hundred to a thousand tons, and that this is a fair basis for calculating the cost of storage." The engineering therm supervision will follow the coal from the mine sample all the way into the furnace and hold the storage conditions to that needed for safe operation. The storage problem is vital to Illinois and Indiana coal as well as to the consumer.

The consumer should have fresh mined coal; from the mine face into his furnace should be the rule. The coal should go at one movement only from the railroad car to the bin feeding the furnace, whether for power plants, locomotives, public utility plants or the heating plant for households. The consumer needs better service and fresh coal; he should not be forced to rely on second hand coal that has been dumped, crushed, redumped, crushed again and left out in all kinds of weather, mixed and remixed.

This subject of second hand coal for the consumer is important and can be, in a large measure, eliminated by therm coal fresh from the mine to the consumer's furnace. Most Illinois and Indiana coal can be burned in a few days from the time it leaves the mine face. Many large consumers follow this procedure and this service should be extended to all classes of users.

Steam and Power for New Boston Post Office

COMPREHENSIVE heating and power arrangements for the new post office to be built at Boston, Mass., have been worked out to include use of purchased electric power and a boiler plant to supply heating steam, according to data issued by the Supervising Architect, Treasury Dept., under whose direction the work is being done.

Boston Post-Office building, when completed will be 22 stories high and will provide quarters for the administrative section and central delivery and mailing section of the Boston City Post Office, the United States Courts, Internal Revenue, Income Tax, Veterans Bureau, Weather Bureau and several smaller Governmental activities. It will occupy an entire city square and will contain about 10,290,000 cu. ft.

About 70,000 sq. ft. of direct cast iron radiation will be installed and about 38,000 sq. ft. of equivalent direct radiation in connection with the ventilating system. The ventilating system will serve the court rooms and the portion of the building occupied by the Post Office. Offices will have only natural ventilation.

All radiation will be on a two-pipe vacuum system, zoned for convenient control and economical operation. To supply the heating, ventilating and domestic hot water requirements, four Murray 300-hp. cross-drum, water tube boilers, with forced draft underfeed stokers capable of operating the boilers at 200 per cent rating, will be installed.

Steam will be generated at 100 lb. pressure which will be reduced to 40 lb. for general distribution and further reduced to 2 lb. for the direct radiation and to 10 lb. for the fan blast radiation.

Condensation is taken care of by two duplex motor-driven vacuum pumps, one for the south half and one for the north half. These pumps are so interconnected that one pump may be used for the entire building.

Vacuum pumps will discharge into a deaerating feed water heater equipped with large storage tank from which duplex steam driven boiler feed pumps will deliver the condensation to the boilers. Provision will be made for heating all makeup water.

In addition to the boiler plant, a connection will be made to the steam mains of the Edison Electric Illuminating Co. of Boston so that central station steam may be used if desired. If central station steam is used, the vacuum pumps will discharge through economizers to the sewer.

POWER PLANT ENGINEERING July 1 1932

Power Utilization

TRAPS

By T. H. Rea*

Size for Process Equipment
Keep Air Out of Heating Coils
Proper Bypasses and Location

SELECTION of traps for draining process equipment such as jacketed kettles and evaporating coils is complicated by several factors that are not usually considered. For instance, a 54-in. jacketed kettle of ordinary construction will have about 32 sq. ft. of condensing surface. Assume that the kettle is filled with a liquid having a temperature of 40 deg. F. and that the kettle is supplied with steam at 75 lb. pressure. When steam is first turned on, condensation will take place at the rate of over 10,000 lb. per hr. and, unless very large steam supply lines are used, pronounced pressure drop will ensue, which will, of course, reduce the rate of condensation but will affect trap capacity to an even greater extent. Accordingly, if very quick cooking is required, as is the case with tomatoes, a trap must be used with sufficient capacity to handle the initial flood of condensate at the reduced pressure.

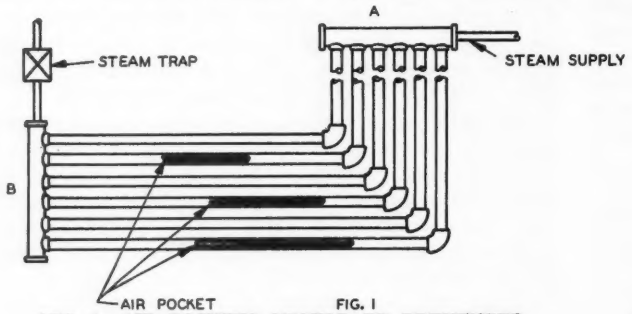


FIG. 1. AIR POCKETS SHOULD BE PREVENTED

As the temperature of the liquid rises, however, the steam pressure will increase and the trap must be able to operate at the maximum steam pressure. To be more specific, if the initial pressure in the kettle drops as low as 40 lb., with steam condensing at the rate of 9000 lb. per hr., a ½-in. orifice would be required for handling this condensate. Such an orifice can be obtained in a 1¼-in. trap for pressures up to 40 lb. This size trap, however, will not open a ½-in. orifice at 75 lb. pressure, so a larger size trap must be used that will open the large orifice at the maximum operating pressure.

If quick cooking is not essential, a 70-lb., 1¼-in. trap could probably be used. At first this trap would back up a little water and air, thereby cutting down the rate of condensation, which would build up the steam pressure so that the trap would be able to handle the load but considerably more time would be required for cooking the product. These remarks apply to any steam-heated process unit that operates intermittently, where the amount of condensate varies inversely with the steam pressure and temperature of the material processed.

Air Pockets

Air pockets frequently form in horizontal pipe coils, especially the type illustrated in Fig. 1. This is due to a number of causes such as unequal lengths of pipe and the way that steam is admitted into header A. Once these air pockets form, they are almost impossible to remove and they reduce the amount of steam condensed by the coil. Usually the trap gets the blame although it should not be held responsible, as it will remove all condensate as fast as it enters the trap. Installation of a large trap will sometimes eliminate the air pockets because, when the trap opens, there will be a slightly greater pressure drop in header B which tends to pump the air pockets out of the coils. This does not mean that the smaller trap will not handle the amount of steam that should be condensed by the coil but rather that the small trap will not drain a coil of that particular design.

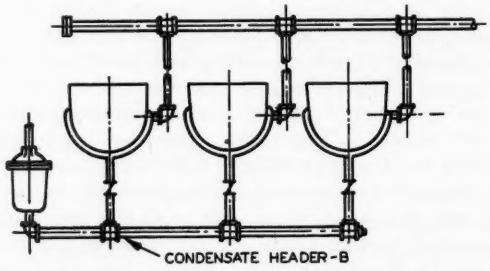


FIG. 2

FIG. 2. MULTIPLE DRAIN MAY BE INEFFECTIVE

Multiple Drainage

Tendency of air to pocket or steam to short-circuit as described in the preceding paragraph is increased when several units are drained by a single trap. If any one of the three jacketed kettles shown in Fig. 2 is filled

*Armstrong Machine Works.

with cold material while the other kettles are at maximum temperature, the chances are that the steam pressure in that particular kettle will drop enough so that steam will back up from header B. As long as steam does enter from header B, condensate and air cannot escape from the kettle and, all too frequently, the trap is blamed for the poor production from the kettle.

Installing a check valve in each discharge line will not solve the problem, as the check valve will close and the condensate and air will remain in the kettle until the pressure is equalized. The only sure cure is a trap on each kettle.

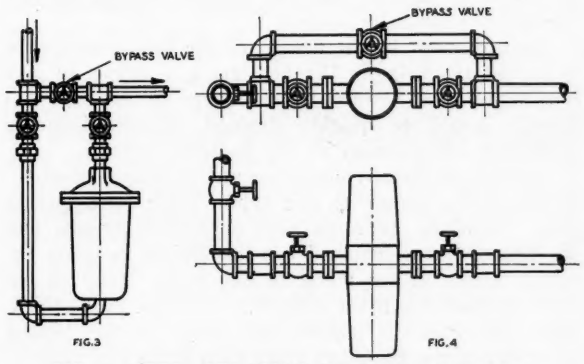


FIG. 3. LEFT. RELATION OF TRAP TO BYPASS
FIG. 4. RIGHT. BYPASS FOR COMPOUND TRAP

When several units drain to a line connected to a single trap, the pressure differential between the units and the return header is usually a matter of ounces or fractions thereof, hence a marked pressure drop in any one of the units will result in a back up of steam and failure to drain until air accumulating in the unit decreases the rate of condensation, so that the pressure is equalized.

With a trap on each unit, even a marked pressure drop will not interfere with the positive elimination of both condensate and air. Sometimes several machines are successfully drained by a single trap but such cases are decidedly in the minority and the best insurance against faulty drainage is the use of individual traps.

Bypasses

Whenever continuous service is of prime importance, steam traps should be installed with bypasses so that the line or machine can be drained through the bypass valve while the trap is replaced or repaired. Whenever possible, traps should be installed below the bypass as shown in Fig. 3. This will prevent loss of priming due to a leaky bypass valve. On the other hand, bypasses should be installed *around* compound or piston operated traps, see Fig. 4. The reason for this is that the capacity of a compound trap is usually limited by pipe friction. If the trap is installed in the bypass, the extra friction of the necessary fittings will materially reduce the capacity of the pipe line.

There is considerable difference of opinion regarding the use of bypasses unless they are absolutely necessary. To offset their inconvenience there is a possibility of steam loss that may run into large figures. A leaky bypass valve is not easily detected, also operators will frequently leave the bypass valve cracked either intentionally or through oversight. One large packing company eliminated all bypasses from production equipment and the resultant steam saving was sufficient to cut out one boiler.

Trap Location

If possible, a steam trap should be installed below the unit or line that it is draining. This permits gravity drainage to the trap and reduces the possibility of the trap losing its prime. If, however, it is necessary to install the trap above the unit, a water seal is advisable at the low point in the line to the trap; likewise a check valve ahead of the trap will prevent backflow and loss of prime in case of sudden pressure drop.

Avoid installation of traps in out-of-the-way places where the traps are bound to be neglected. This raises the question of systematic trap inspection to prevent steam loss on account of mechanical or operating troubles. A piece of scale or pipe lodging between the valve and seat will sometimes let a trap lose its prime and blow through. With a regular inspection routine, this condition will be discovered and corrected with the minimum of delay. Not only is steam saved but excessive trap wear is prevented. Prompt replacement of worn parts, lapping in of leaky valves and a periodical reconditioning will keep trap maintenance at a low figure and will insure that the traps perform their intended function, that of always removing condensate but preventing the loss of live steam.

Belt Conveyor Pointers

PROPER DESIGN and wise selection of parts, which determine the success of a belt conveyor installation, cover the belt to carry material, idlers to support the belt, drive for operating, delivery of material in loading, discharge of material at the end.

The belt, which is subject to wear and tear from contact with the material handled and from driving strain, is the most expensive part to maintain, hence every care should be taken to select the belt that will be most economical in the long run and to protect it as much as possible from wear and injury.

Loading should be so planned that material will reach the belt in the same direction and speed of motion that the belt has, with as little drop and impact as practi-

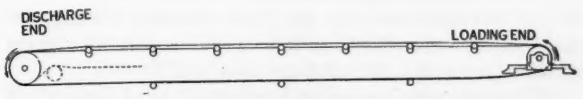


FIG. 1. CONVEYOR DRIVE AT DISCHARGE END

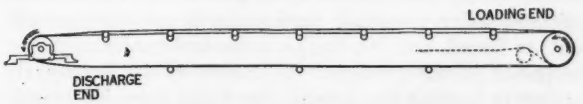


FIG. 2. DRIVE AT THE LOADING END IS TO BE AVOIDED IF POSSIBLE

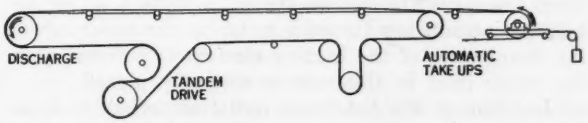


FIG. 3. HEAVY WORK REQUIRES TANDEM DRIVE WITH AUTOMATIC GRAVITY TAKE UP

cable, especially where material is heavy or abrasive. Weight of fabric, number of plies, thickness and grade of surface covering are points that should be covered in specifications according to the conditions of service.

In all cases, anti-friction idlers are recommended for long life and low maintenance costs of idlers and belt.

Proper type of drive may mean a saving in extra thickness of belt or in reduction of strain on the belt. Both drive and idlers have a bearing on the economy of the conveyor and the thickness of belt needed to transmit the driving pull. In Fig. 1 the drive is at the discharge end, where it had best be placed to give least belt stress. It may have a snubber pulley, as shown dotted, to give greater arc of contact with the driving pulley. Link-Belt Co., by whom data and cuts were furnished, assumes 215 deg. arc of contact to give greater pull without slipping.

Drive pulley, if unlagged, has a coefficient of 0.25, while, if rubber lagged, the coefficient is 0.35, giving greater ability to transmit belt pull. Particularly where no snubber is used, the rubber lagging is advisable.

Drive at the loading end as in Fig. 2 should be avoided if possible but may be used on light drives where any other arrangement would be impracticable or inconvenient.

For heavy work, the tandem drive, Fig. 3, is effective and can be located at any convenient point on the return side, near either head or tail end or with discharge over one of the drive pulleys. For this drive, automatic gravity take up should be provided as shown.

Service Water Heaters

REFERRING to the article by W. J. O'Brien in the May 15 issue, the heater under discussion is a horizontal, cylindrical tank containing a heating element made of a number of hair-pin tubes rolled into a header that is partitioned to accommodate the steam inlet and the condensate outlet. Cold water inlet to the tank is in the bottom at the same end as the steam header, and hot water outlet is from the top of the tank at the opposite end. Mr. O'Brien says that this arrangement "is contrary to the principles of heat exchange, as the cold water should be connected to the point where the temperature of the heating medium would be reduced, that is at the opposite end from the heating element inlet. Then the hot water should be taken from the top front over the heating element, as shown in his Fig. 2, to avoid expansion strains which shorten the life of the tubes and shell."

Whether there is a reduced temperature of the heating medium (steam) depends upon the drainage of the element. If the condensate is carried out of the element without filling the tubes, then steam is present throughout its length and the temperature is constant and corresponds to the pressure. If, however, the condensate is slow in leaving the element, due to its excessive length, its lack of sufficient pitch or to sluggish action of the trap, then the lower portion will be filled with condensate and its temperature at the discharge end can be much lower than that of the steam. If there is an advantage in introducing the cold water at the point where the temperaure of the heating element is reduced, then the water inlet in this case is correctly placed.

Location of the hot water outlet is probably immaterial. Its location at the opposite end from the cold water inlet was probably dictated by the belief that the water would then traverse the full length of the heating element. When you consider that water being heated rises by convection and pretty rapidly, too, you will realize that the position of the outlet is a matter of convenience, or whim. The incoming cold water, because of its greater density, will diffuse over the lower zone of the tank and, becoming heated, will rise and spread rather uniformly through the upper zone.

Drainage of a heater of this kind is of the utmost importance. The coefficient of heat-transfer between the condensate in the tubes and the water in the tank is but a fraction of that between the steam and the water, so you might assume that any surface covered by condensate is practically useless.

Improvement in the design of the heater would be to spread the hair-pin U-tubes into a V shape, to give continuous pitch toward the discharge so that the condensate would be quickly drained, thereby insuring maximum effectiveness of the heating surface.

There need be no concern about "expansion strains" in tubes of a heater of this type. Their form, giving great flexibility, prevents high expansion stresses and the temperatures involved are insufficient to cause excessive stress in the metal of the tank. Many steam-boiler drums of half the diameter, twice the metal thickness and twice the temperature range of this heater, have been in use for many years with no sign of distress.

Los Angeles, Calif. C. O. SANDSTROM.

Clean Copper Dust Between Slip-Rings Frequently

AN ITEM UNDER maintenance of electrical equipment that is often neglected is that of preventing copper dust from accumulating between slip rings on rotating electrical equipment. If this is allowed to accumulate in such amount that the resistance is considerably lowered between these rings, a flashover is almost sure to result, especially where a high voltage is impressed between the rings. Once an arc is started, serious damage to the windings will usually result.

One example of this came up recently in the case of a 2300-v., 750-hp., wound rotor, induction motor. As the motor was comparatively new, the maintenance program did not call for further than a check-up on power consumption and speed of this motor. The copper dust had gradually formed a coating on the ring mounting and one day when starting up caused a flashover. The arc carried across all three sets of brush-holders and pigtails and finally grounded on to the fan blades (for cooling). The power was shut off before damage had been done to the windings but in many cases such trouble will probably result.

A coat of insulating varnish applied to the insulation between the rings will give a hard, glossy surface that copper dust will not easily stick to and will allow it to be easily wiped off as it does accumulate.

Boston, Mass. HARRY M. SPRING.

REDUCED weight and easier fabrication by welding are features expected to be secured by use of special 2½ per cent nickel steel for hull and part of the frame construction of proposed U. S. liner ships. The saving in weight is estimated at 1300 t. in boats 1000 ft. long which are designed to carry 2800 passengers and make the Atlantic Ocean crossing in 4½ days.

The Full-Automatic Ice Plant

By M. G. Munce*

IN THE SPRING OF 1930, the Virginia Ice & Coal Co. erected three 15-t. full-automatic ice plants at three widely scattered locations within a radius of fifty miles of Richmond. Since they were the first full-automatic ice plants to be erected they attracted attention with various prophecies, conjectures and predictions as to their future and success. We have now successfully operated two seasons and are very happy to report that the full-automatic control has withstood every demand and test made upon it.

To refrigerate our ice storage, we have a small compressor, condenser and water circulating pump; to refrigerate our ice tank, a large compressor, condenser and water circulating pump; and to furnish the entire plant with water in lieu of a town or city supply, we have a well pump and pressure type water tank. These are all interconnected, electrically and mechanically, so that they can be operated individually or all together as one and under either manual or automatic control.

Motors are started one after the other as follows: A thermostat in the brine tank starts the large condenser water circulating pump. When this pump has come up to speed and has built up its normal pressure in its discharge main, the pressure in the main closes a water pressure switch, which starts the large compressor. Thus one motor after the other is thrown on the line and the same is true when the motors are stopped and the motors are thrown off of the line. When the brine temperature has been reduced by the operation of the compressor on the tank coils to a predetermined point, the thermostat stops the water circulating pump and the failing pressure in the discharge main of this pump stops the compressor.

Similarly a thermostat in the ice storage room operates the small condenser water circulating pump, which in turn by means of another water pressure switch operates the small compressor. Water pressure switch connected to the pressure type water tank controls the operation of the well water pump, starting the pump whenever the pressure in the tank drops below a predetermined point and stopping it as soon as the desired pressure is restored, more or less the same system used on farms and such places for independent water supplies.

Perhaps you will think from the foregoing brief description that the full-automatic plant is quite inflexible. This is not true. The reverse is the case, for the two refrigerating systems can and are actually operated in five different and distinct ways, depending upon seasonal and other demands on the plant and equipment.

1. Small compressor automatically maintaining temperature in ice storage and large compressor automatically maintaining temperature in the ice tank, each system operating independently of the other.

2. Both small and large compressors operating together and automatically maintaining temperatures in both ice storage and ice tank, both systems operating as one.

3. Large compressor automatically maintaining temperatures in both ice storage and ice tank, small compressor being out of operation.

4. Small compressor automatically maintaining temperatures in both ice storage and ice tank, large compressor being out of operation.

5. Any single machine or piece of equipment in or out of operation as may be required by some very unusual demand, the balance operating on hand control.

During peak summer demands, we use the first method of operation and then as the season wanes, the second, the third, and finally the fourth during the periods of minimum demand. Of course, the fifth method is only resorted to in the event of some break-down or some other very unusual circumstance. Regardless of seasonal demand on the plant, the plant is always under full-automatic control and temperatures are always maintained within the desired range.

Defying all approved ice plant practice, we pull all of our ice in the daytime, under peak conditions pulling half of it in the morning and half in the afternoon and otherwise pulling all of it in the morning. This has permitted us to do with only one manager-operator except during the peak season when we take on a second plant man, not on account of the duties inside of the plant but simply because we must keep the plant open from about five in the morning until eleven at night. During this period, on account of the heavy loading of trucks, we work both of them in the forenoon, one in the afternoon and one in the evening. This peak lasts for about three months and just as soon as it is over we drop the second man. In other words, the platform sales require the second man, not the plant duties.

Experience indicates that with a given layout making the plant full-automatic increases the cost of the machinery and equipment approximately 10 per cent. This refers to a new plant. Converting present manually-controlled plants to full-automatic control would naturally be a little more expensive, the amount depending entirely on the layout and equipment installed, but in almost any event I do not think the cost would be in excess of 15 per cent of the machinery and equipment cost.

*Virginia Ice & Coal Co. From a paper presented before the Virginia Ice Mfg. Association Convention.

ELECTRIC POWER is doing all the pumping for 300 of the 358 Michigan communities which have public waterworks systems, according to a survey recently completed by the Utilities Information Bureau of Ann Arbor, Mich. Electricity is used with steam in pumping the supplies for 12 additional communities, in combination with Diesel engines in two communities, with water power in one and with gravity in one. Twenty-eight other communities use electric power for stand-by and emergency pumping service.

Steam, which once ruled the waterworks pumping field in the state, has been retained as principal pumping agent by only 21 communities. Water power is used for pumping by seven waterworks systems, oil engines are used by three, gasoline engines by five, oil and gasoline by one, a hydraulic ram by one, and a windmill—with electric power stand-by—by one. Gravity furnishes the supply for three systems.

ABILITY to start up and take load quickly makes hydro electric units ideal for standby use to pick up sudden peaks and for emergencies.

POWER PLANT ENGINEERING July 1 1932

Diesel Engineers Meet in Pennsylvania

FIFTH NATIONAL MEETING OF THE OIL AND GAS SECTION OF THE A.S.M.E. HELD AT STATE COLLEGE, PA., JUNE 8-11, 1932. BY L. H. MORRISON*

FROM June 8 to June 11, the fourth annual meeting of the Oil and Gas Power Division of the A.S.M.E. was held at Pennsylvania State College with a registration of over 200 engineers, together with 40 ladies, for whom especial social features were included in the program.

Wednesday morning was devoted to registration and a fuel technical session at which were presented the papers "Heating Fuels for Injection Engines" by E. A. Richardson and "Spray Characteristics of a Jerk-Pump Fuel-Injection System" by O. F. Zahn.

Mr. Richardson advocated the heating of fuels to the self ignition temperature before injection. Three major reasons were given in the support of this theory: to reduce the viscosity of the fuel so that it could be handled by the fuel injection system; to overcome the ignition lag by heating to such a temperature that the fuel will ignite upon contact with air; to heat the fuel so that it is effectively a gas on injection and may burn directly and rapidly without the delays of drop transformation.

In discussing Mr. Richardson's paper, J. C. Groff, Bethlehem Steel Co., mentioned that the idea of preheating the fuel is not new and cited several patents, including an early one of Dr. Diesel. He added that the Bethlehem Steel Co. experimented with hot-oil injection in 1920, with some success. Best results would be obtained by heating the oil after passing the pump.

Julius Kuttner sees no future for the system advocated by Mr. Richardson and claimed that at present carbon deposits upon the exposed tip of uncooled spray valves, and predicted increased trouble if the oil is heated.

On the other hand Col. O. F. Allen thought that Mr. Richardson's paper was a valuable contribution and, since heating of some oils is necessary, advocated an increase in heating to above the critical value.

ATOMIZATION AND COMBUSTION STUDIES

Spray characteristics of a jerk pump fuel injection system as determined at the Pennsylvania State College laboratory were outlined by O. F. Zahn, Jr. Of the three possible variables: engine speed, load and nozzle opening pressure, the last was determined to be the only one producing a notable effect on combustion, the higher pressures giving a greater angle of spray and a greater fineness of atomization.

Discussing Mr. Zahn's paper, D. W. Lee of Langley Field said that to obtain an idea of the distribution of an oil spray, the N.A.C. A. employ a plastic material.

E. T. Larkin, Sterling Engine Co., asked how such investigation could be adapted to commercial engine design and doubted the value of the work.

Dr. Dickinson, Bureau of Standards, stated that flame speeds were increased above static conditions and expressed the belief that the paper is a valuable contribution to the science of fuel injection, in which he had the concurrence of E. J. Kates; the latter thought that other pumps might be tested in like manner.

Professor Everett, in charge of Mechanical Engineering at Penn State commended the paper as to the manner in which it presents the results of the experiments.

The first paper of the Wednesday afternoon session was "Surface-Volume Rates as a Critical Factor in Automotive Diesel Combustion Design," by Julius Kuttner, American representative of the Oberhaensli & Cie.

In spite of the advantages of the Diesel engine, needs of the automotive field are still being met by other types of engines according to J. Kuttner. This is due largely to the large ratio of cylinder surface to volume occasioned by the small bore cylinder. This handicap is being overcome by subdividing the chamber and designing it as a heat accumulator rather than a dissipator. This type of chamber is expected to displace the simple chamber small bore engines.

In a discussion mailed from Germany, Dr. Neumann described tests he has run on the Oberhaensli engine. The favorable results were attributed to heating effect of the hot element, for the engine design has a very unfavorable surface-volume ratio.

C. T. Vincent, Continental Motor Co., doubts, so he stated, that the ratio deserves the importance Mr. Kuttner gives it. His own tests fail to bear out the claims the paper set up and he claimed that other factors are of greater importance.

The author closed by stating that low compression is desirable because ordinary gasoline engine parts can then be used; that Mr. Lipetz used for comparison an engine above the automotive range in size; that higher speed does not offset surface-volume but the effect is not available when engines are idling or pulling slowly.

Another paper of fuel spray formation by D. W. Lee, of Langley Field, gave the results of experiments by the N.A.C.A. High speed spark photographs and spray impressions on lampblack surfaces reveal the process by which the fuel is transformed from a solid jet to the atomized spray. Variables investigated included different type nozzles, injection pressure and density of chamber air.

In discussing the paper by D. W. Lee, Dr. Schweitzer, Penn State College, said that the Research Department of Penn State is doing the same work as discussed in the paper but along somewhat different lines. He and his associates find that the oil drops are much smaller than the diameter mentioned in the paper indicates.

Col. O. E. Allen expressed the opinion that 200 lb. is too low a pressure to employ and suggests that 400 lb. be employed, thereby simulating working conditions.

Combustion knocks are not unknown in Diesel engines but this knock has little in common with the similar knock in the gasoline engine as was explained by P. H.

*Chairman Oil and Gas Division American Society of Mechanical Engineers.

Schweitzer. Almost every factor which causes a gasoline engine to knock is likely to make a Diesel engine run smoother. What is anti-knock in a gasoline engine is pro-knock in a Diesel. This is because the knock in a gasoline engine is due to the last portion of the burning gas while the knock on the Diesel comes from self ignition at the beginning of the stroke. Cutting the ignition lag and reducing the amount of fuel injected during the lag period reduces the Diesel knock. Knock or rough going is usually associated with high maximum pressures. It is, however, the rate of pressure increase rather than maximum pressure that causes the knocks, the steeper the pressure rise the greater the knock.

Discussing Dr. Schweitzer's paper, H. K. Cummings, Bureau of Standards, claimed that ignition lag is a better method of studying oil fuels. W. H. Butler, Standard Oil Co. of N. J., favored the use of a table to examine fuels in the field. He has compiled Octave Numbers on eight fuels on a C.F.R. test engine and found that the results checked closely with the predictions based on the chemical characteristics of the fuels. He favored the "Analine Number" test method.

E. Nibbs, Chief Engineer, Electric Boat Co., claimed that open nozzles permit control of combustion. As low compressions cause ignition lag, he predicted that the high-speed Diesel will eventually go to pressures of over 500 lb.

G. W. Baierlein, United American Bosch Corp., said that ignition lag is affected by the size of the oil droplet and that the shape of the combustion chamber influences the lag.

Julius Kuttner cited his experiments in obtaining proper ignition at low speeds, and claimed that excellent results were obtained by the addition of a governor to advance the point of injection at low speeds.

Problems of the Designer

At the Thursday morning session Russell J. Allen, Worthington Pump & Machinery Corp., presented a paper on "Metallurgical Problems of Diesel Engines," in which he stated that he did not consider the metallurgical problems of the Diesel engine serious as they consist more in selecting the most suitable material for a given application than in trying to find the solution for a chronic condition. The majority of the problems encountered in operation are fundamentally those of design but for economical reasons they often become metallurgical.

Dr. De Juhasz, Penn State College, in discussing the lightening of engine frames, mentioned that the idea of employing aluminum, with steel re-enforcement to take tensile stresses, is worth investigation. To this P. B. Jackson, Aluminum Co. of America, stated that the ideal engine frame is one of aluminum in compression, with steel wires or studs to bear the tensile stresses; 55,000-lb. compression strength is within the range of aluminum.

Because of its simplicity and ease of operation, the two cycle gas engine attained popularity in the oil industry. As higher efficiency was demanded the four cycle engine was developed by most manufacturers. Advantages of the two cycle engine remain, however, and a new type of two cycle gas engine was described by E. H. Beardsley and J. M. MacKendrick, Jr., both of Clark Bros. Co. In this engine, gas from the line is injected into the cylinder after the exhaust ports are closed. By reducing the loss of fuel through these ports the efficiency of the new engine closely approaches the four cycle engine while the simplicity, cheap construction and ease of operation of the two cycle engine is retained.

Mr. Shoemaker asked a question on detonation and compression ratio; the reply to this was that with compression pressure of 95 to 100 lb. there would be no detonation unless the gas were bad.

Cost Committee Report

On the Friday morning program, the first feature was the presentation of the Report of the A.S.M.E. Diesel Power Cost Committee by M. J. Reed, the committee's secretary.

In discussing the report, which was distributed too late to enable the engineers to digest it, Otto Nonnenbruch inquired as to the number of such reports issued by other bodies and as to the acceptance of the A.S.M.E. report. To this Mr. Reed replied that three bodies issued reports but these were in the main data obtained in haphazard fashion. The A.S.M.E. report was winning general acceptance by reason of its impartiality and completeness.

Diesel Economy

The later part of the session was devoted to the presentation and discussion of the paper "Improving Operation and Overall Economy of Diesel Generating Station" by H. W. Stalnaker.

Improved operation and overall economy of Diesel stations can be attained by the use of selected boiler fuel oils and more intelligent supervision. The majority of Diesel plants are operating far below par, said Mr. Stalnaker, and if real economical operation is to be obtained better supervision is necessary. Costs of some plants reported in the cost committee report were analyzed and opportunities for improvement pointed out. One of the possible sources of saving is by the use of cheaper boiler fuel oil. He thought that rather than demand an oil which could be burned easily in an engine, the engine should be built to burn the oil available from present refinery processes.

G. R. Christy, Standard Oil Co. of N. Y., in discussing Mr. Stalnaker's paper took the stand that Mr. Stalnaker does not understand the position of the refiner. Boiler oil, so he stated, is not a drug on the market and he doubts if it can be employed successfully in most Diesel engines. He favors the use of a refined oil even at an increased price.

Louis R. Ford had a contrary view and thought that unless motorships burned the same cheap oil as does the steamship, the Diesel will not be installed in new American shipping. He believed that boiler oil can be burned when properly treated.

Several others joined in the discussion but the most valuable contribution was by Lee Schneitter, Electric Bond & Share Co., who stated that his company burned Bunker C oil in slow Diesels with a marked overall profit.

At the Saturday morning session, E. S. Dennison presented a paper on "Inertia Supercharging of Engine Cylinders". This paper dealt with the mathematical procedure of ascertaining the correct length and diameter of the intake pipe of an engine, to enable a supercharging effect to be obtained. It was found that such an effect will result if the piping is of the correct length.

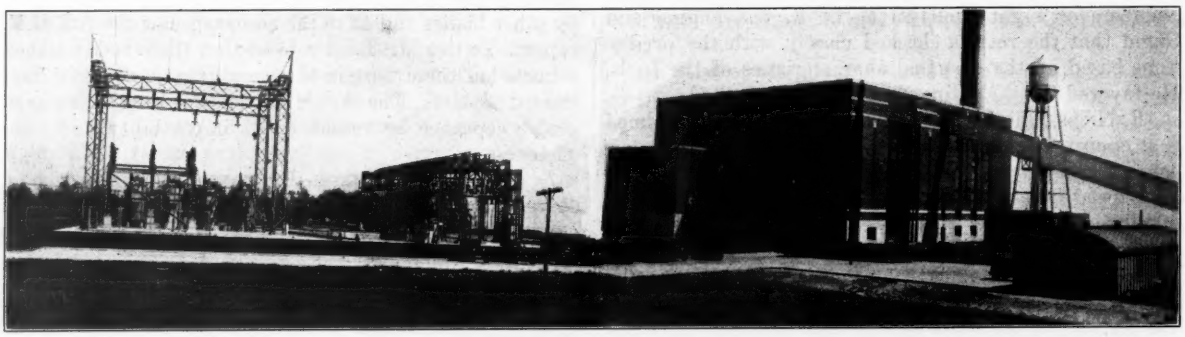
POWER PLANT ENGINEERING July 1 1932

Edgewater Station at Sheboygan in Service

NEW 675-LB., 825-DEG., F., 30,000-KW. STATION OF THE WISCONSIN POWER & LIGHT CO. HAS MANY INTERESTING DESIGN FEATURES

STARTED in 1930 and recently completed, the design of the new Edgewater Station of the Wisconsin Power & Light Co. involves a number of innovations in power plant construction. No curtain wall is used between the boilers and turbine; practically all auxiliary equipment is located in the basement; Rossman drive is used extensively to give flexibility of operation and a new design of circulating water intake is expected to give cooler water with an absence of ice trouble.

Perhaps the most interesting feature is the circulating water system. The intake is a bottle shaped well in the lake about 1500 ft. from shore in 18 ft. of water. Openings are provided for water near the bottom, and it is connected to an auxiliary intake near the shore by two 54 in. steel pipes so arranged that water can be taken in through one and discharged through the other to the main intake in case of needle ice trouble. This auxiliary intake, located near where the discharge



At present one 30,000 kw. Allis-Chalmers turbine and two Babcock & Wilcox 300,000 lb. per hr. pulverized fuel boilers are installed but the building itself is large enough to house another 30,000 kw. or larger unit and one more boiler, leaving one boiler per turbine with one spare. The turbine has a flat water rate designed to take care of the fluctuating load expected during the initial operation.

Calumet boilers with steaming economizers and air heaters are designed for 675 lb. 825 deg. F. and have water cooled Bailey furnaces with water cooled slag tap bottoms which are tapped to an Allen Sherman Hoff sluice. Each boiler is fired by two Kennedy Van Saun pulverizers. Belt conveyors take the coal from the track hopper, through the crusher to the overhead bunkers. Temporary storage facilities are provided by a locomotive crane.

Absence of the curtain wall between boilers and turbine simplifies construction and operation. Furthermore, with practically all the auxiliaries in the basement carried on the basement floor slab, the only weight of any consequence to be carried by steelwork consists of the building walls and roof, coal bunkers and conveyor. This feature had a marked effect on reducing the cost of the station.

The concrete chimney is located outside of the plant with a short smoke flue connecting it with the induced draft fan. Both of the draft fans are located in the basement immediately under the rear end of the boiler so as to give short smoke and air passages. These fans are driven by Rossman variable speed alternating current drives to provide flexibility and low auxiliary power consumption over the load range expected.

empties into the lake, is provided with gates so that recirculated water can be taken in at this point. From the auxiliary intake a tunnel leads to the screen chamber adjacent to the building. From the rear of this chamber the circulating pumps, one for each unit, take their suction.

In addition to the 12.5 kv. switchyard at generator voltage, there is a 132 kv. switchyard on the transmission line which connects to the loop around Chicago. One 132 kv. steel tower line constructed in connection with the new plant runs through to Janesville and Fond du Lac while another similar line runs from Janesville to the state line where it connects with the Chicago loop system through Waukegan Station. The station was designed by Sargent & Lundy, Inc.

IN MANUFACTURE of electric motors, oxy-acetylene welding is being used by a west coast company to bond the station wires. Formerly this was done by soldering, which involved scraping bright. At the suggestion of a welding operator, correct procedure for bronze welding was found, after a little experiment. For larger wires of square section, the ends are held together by a small copper clip, placed a little back from the ends. One wire protrudes a little farther than the other and clip and wires are bonded in one operation. For round wires, the ends are twisted together, then fused without need of cleaning or welding rod. Damp cloths are placed inside and outside the row of coil terminals, to protect the insulation from heat. This method is, of course, applicable to repair or rewinding jobs, the time saved being some 2½ hr. on the stator of a 20-hp. motor.

Readers' Conference

Smokestack Corrosion

SEVERAL TIMES I have noticed articles discussing smoke stack corrosion or asking for the experiences of others along this line. We have at this plant the Blackwell Lumber Co., a steel stack 6 ft. in diameter, 180 ft. high, connected to six return tubular boilers, burning hog fuel and sawdust which contain a large quantity of moisture. During the hours when the plant is idle and the outside temperature is cool, fires are carried with the stack damper closed. Conditions at this time are just right to form creosote which runs down the stack in large quantities. Corrosion takes place where the creosote lies against the stack and is burned.

Figure 1 shows where a crack appeared and upon investigation we found the stack nearly eaten off all around. The breeching was all that was holding the stack. Emergency repairs were made as in Fig. 2. Six 6-in. I beams 32 ft. long were bolted to the stack to support it until repairs could be made at the end of the season and new sections put in.

Figure 2 shows how the false bottom was put in with the top of the brick work along the exact line where corrosion took place. Figure 4 shows how the new bottom has been installed. This will, I think, do away entirely with the corrosion of the stack sheets. Cross-section A shows the cast-iron ring in place with the brick filler. B, a cast iron ring 12 in. high 1 in. thick is cast in quarter sections and bolted together to form a ring 2 in. smaller in diameter than the inside of the stack. This leaves an air space around the ring C supporting channel irons on which rests steel plate D and brick filling E. F shows air space and drain for creosote to find its way to bottom of stack and out to the ground.

In stacks where the creosote condition exists, creosote runs out between the laps and destroys the paint. If the stacks were built as in Fig. 6 with the laps reversed instead of the usual way as in Fig. 5 the paint trouble from creosote would be done away with and conditions would be much more satisfactorily from the maintenance standpoint.

Coeur D'Alene, Ida. L. E. HAYBARKER.

Let's Exchange Information

EVERY ONCE in a while I make contact with concerns who ask me to "withhold information." The president says, "We don't mind telling you how we do this, but please don't publish the information. We don't want it to reach our competitors. It is our bread and butter."

Of course I do not violate the confidence of anybody like that, but I have yet to be convinced that much if anything is ever gained by such practice. I know that most of these executives diligently read the magazines and are on the lookout for helpful information. In other words, they are willing to take advantage of any data given to the world by others without giving anything in return. It is obvious that if every manufacturer in the world, from the beginning of civilization, had kept his processes "in the dark," there would have been no processes at the present time. In fact, there would be no manufacturers. We have progressed because neighbors, competitors, states and even nations have "compared notes" and are continuing to compare notes. We have learned much from foreign nations through the printed word and they in turn have learned much from us, all of which is as it should be.

Here is an example of "information wanted":—I have been endeavoring for some time to secure some worth while data on draft losses through water-tube boilers. A great many curves, formulas and tables have been published on the subject but they all disagree with each other to such an extent and are so obviously uncertain that computations by individuals like myself, who are wholly dependent upon such information, are decidedly unsatisfactory. If any reader has a formula

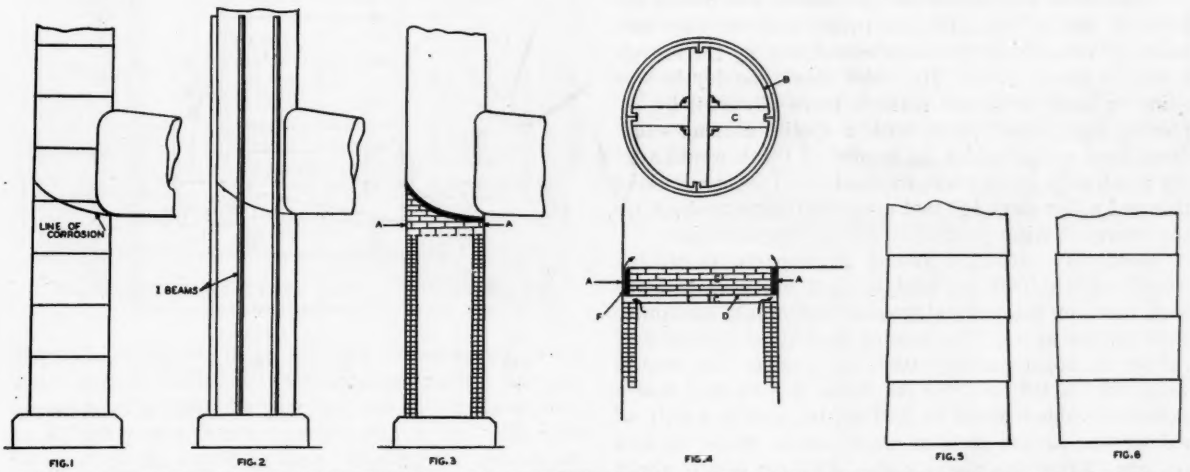


FIG. 1. SHOWING THE LINE OF CORROSION. FIG. 2. FALSE BOTTOM INSTALLED. FIG. 3. I-BEAM REINFORCING ON OUTSIDE. FIG. 4. DETAILS OF FALSE BOTTOM. FIG. 5 USUAL AND FIG. 6 RECOMMENDED METHOD OF BUILDING STACKS

or rule that will accurately foretell draft drop in inches of water, I shall be delighted to see it published.

In this connection, here is a formula of my own which I developed and have used on numerous occasions for determining the efficiency of large coal burning water-tube boilers. It shows how important flue-gas temperature is:—

$$E = 100 - \frac{625\ T}{H}$$

Where E = boiler efficiency in per cent;
T = temperature of exit gases in degrees F.;
H = heat value of coal in B.t.u. per lb.

The formula is based on the results of many tests with the boilers operating at their best—clean surfaces, good CO_2 conditions, ample furnace size, baffle walls tight and properly designed, setting walls tight, sufficient draft, etc.

Newark, N. J. W. F. SCHAPHORST.

Rubber Versus Steel

SOME TIME AGO one of our toolmakers was telling me about a model airplane his twelve-year-old boy had made; it was a good flyer and was driven by the energy stored in rubber bands. He added that some day he was going to improve it and make it more powerful by replacing the rubber bands with a special chrome vanadium steel spring which he seemed to think would supply much more energy when wound up. I rather doubted this and a few days ago had an opportunity to check up the energy storing properties of the two materials.

Good soft rubber, I found, if properly vulcanized would stretch 1000 per cent without breaking and the load, based on the original cross section, would amount to 4500 lb. per sq. in. The specific gravity of this kind of rubber is approximately 0.96, so a cubic foot would weigh $62.3 \times 0.96 = 59.8$ lb. From this we find that a pound of rubber would be 28.9 cu. in., that is a strip of rubber one square inch in cross section would be 28.9 in. long. After this was stretched 1000 per cent it would be 289 in. long, which would be an actual increase in length of 260.1 in. If the stretch is approximately equal to the load, then the work done will be

$$\frac{4500}{2} \times \frac{260.1}{12} = 48{,}800$$

or let us say, in round numbers, that 50,000 ft.-lb. of energy can be stored in 1 lb. of rubber.

High grade chrome vanadium spring steels are available which have an elastic limit of 200,000 lb. per sq. in. and a modulus of elasticity of 30,000,000. A square inch bar of this steel would be 3.53 in. long to weigh 1 lb. and its length when stretched to the elastic limit would be an increase of

$$200{,}000 \div 30{,}000{,}000 \text{ or } \frac{1}{150} \text{ increase.}$$

This would make the final length 3.5535 in. or a travel of 0.0235 in. The work done this time will therefore be

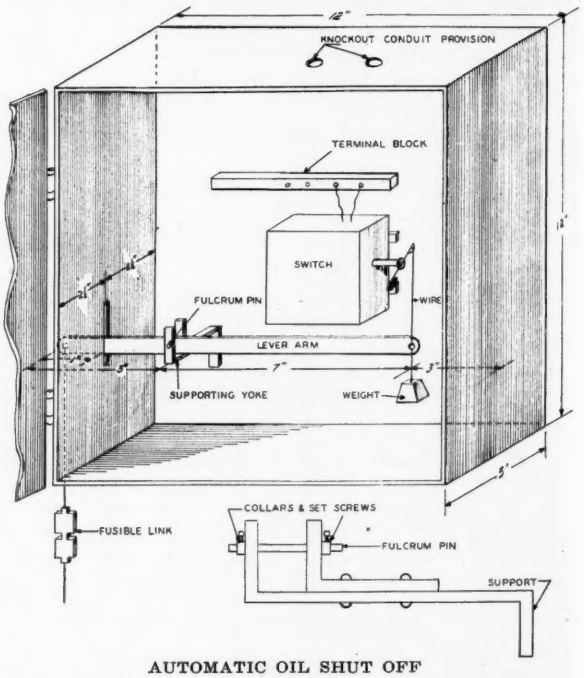
$$\frac{200{,}000}{2} \times \frac{0.0235}{12} = 196 \text{ ft.-lb.}$$

or in round numbers say 200 ft.-lb. This shows that it is possible to store 250 times the amount of energy in rubber as in the finest steel, the weight being equal. The toolmaker's son was therefore using much better judgment than his dad imagined.

Moline, Ill. GEO. P. PEARCE.

Automatic Oil Feed Controller

SHOWN BY the sketches is an easily made device for reducing the possibility of serious fire in oil burning installations. In apartment house heating boilers of the oil burning type, which are unattended, if the burner goes out momentarily and again clears itself, a fire may probably result, due to the hot oil igniting and flowing out onto the floor. In power boilers there is the same possibility especially after a flareback, during the time interval necessary to get the emergency oil valve closed.



AUTOMATIC OIL SHUT OFF

The metal box shown is mounted on the furnace front above the lower (ashpit) doors. A fusible link is inserted in the ⅛-in. wire cable which connects the outer end of the lever arm with a ring in the floor. This fusible link is rated at about 140 deg. F. In case the burner goes out and again clears itself so as to cause burning oil to start out of these doors, the link will melt and the weight on the other end of the arm will cause it to drop. A wire cable from the weighted end of the lever arm connects directly with the lever type switch mounted on the back of the box directly above the arm. If the oil pump is motor-driven, this switch operates a relay tripping off the motor and also sounding a bell alarm through an auxiliary relay. If the oil pump is steam-driven, the switch operates a solenoid valve in the oil line from the pump to the burners and may also sound an alarm.

Boston, Mass. HARRY M. SPRING.

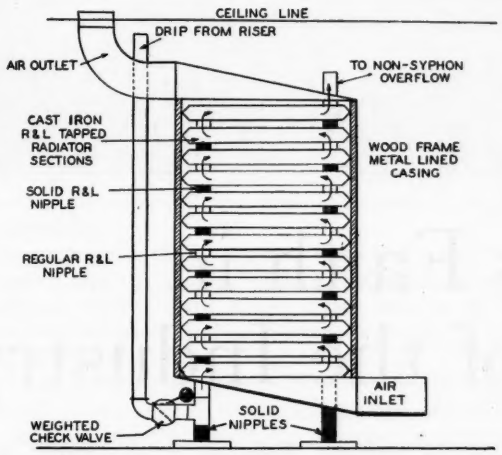
Reclamation of Heat from Condensate

DURING a discussion of the high cost of street steam, several methods of reducing this cost were brought up, among them the following which I believe could be used to advantage in many plants; while it is of the heat ex-

changer idea, it could in most cases be constructed by the maintenance crew and to the engineers who find keen enjoyment in putting to practical use creations of their own handicraft this article will appeal.

Most all customers of the street steam company find a use for the heat of the condensate in heating their hot water supply, but, during periods of peak loads on the heating system and low water demand, the hot water supply is heated more than is desired, unless some provision is made to prevent it.

The sketch shows an indirect radiator of special construction that permits the water in the condensate to take a long travel through the ascending leg of a



RADIATOR BUILT UP TO RECLAIM HEAT FROM CONDENSATE

loop. This radiation being enclosed acts as a form of hot water indirect radiation, a non-syphon overflow line connected to this radiation carrying the cooled water back to the sewer or steam company's return, but only after the heat of the liquid is used. Cooling the condensate 100 deg. is approximate to saving 10 per cent of the steam purchased.

Radiation is used to reduce the condensate temperature, the radiator being installed at the foot of a return riser or across the return main. It provides for additional space heating and at the same time reduces the temperature of the return, but to reduce the temperature of the return with a minimum of cooling surface it is essential that all parts of that cooling surface should be exposed to the condensate. The condensate should be in thin streams, as in the ordinary tubular radiator, so that rapid action in cooling is possible. The ordinary cast-iron radiator, direct and indirect, is generally unsuited for this work, as it is possible that much of the surface will be bypassed, the condensate taking the shortest path from the inlet to outlet or the diameter of the condensate passages being too large to effect a rapid cooling.

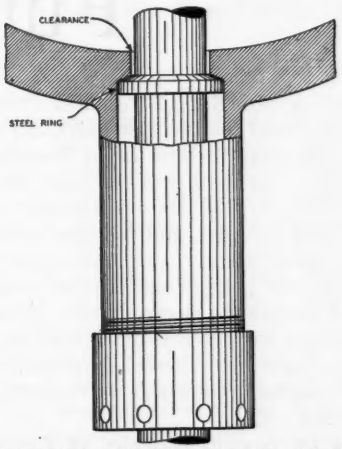
How this radiator can be built from the ordinary cast-iron radiator is shown in the accompanying sketch. The dark space between sections denotes a plugged right and left hexagon nipple and the white space at the other end of section denotes a regular right and left hexagon nipple. The arrows show the flow of condensate from section to section. A weighted check valve should be installed as shown to regulate the flow of water into the radiator; this is also essential when the loop is not balanced with the pressure upon it.

Brooklyn, N. Y. WILLIAM ANDERSON.

Loose Packing Gland Causes Cylinder Knock

ONE OF THE TWIN cylinders of a vertical double-acting ammonia compressor developed a sharp slamming sound. The operating man's first surmise was that a broken valve spring was the cause, but he abandoned this idea when he noted that the slam occurred just as the piston completed about one quarter of the up stroke. Experience had taught him that the ringing sound which denotes failure of a valve spring usually is heard when the valve opens. In the case of a discharge valve this occurs as the piston approaches the end of a stroke, while in the case of a suction valve it occurs just as the piston is fairly started on a stroke.

While feeling around for a clue to the trouble, the operating man was sensible of a distinct jar, as of something striking inside, when he placed a hand on the piston-rod stuffing-box; so he shut down and pumped out the machine and proceeded to pull the packing. The packing had been inserted in two sections, with a perforated steel gland or lantern intervening. When the lantern was dropped out, not a vestige of packing was



JUNK RING KEEPS ROD PACKING FROM SQUEEZING INTO CYLINDER

found above it. Two rings of metallic packing, along with several rings of fibrous material, had been pushed in ahead of the lantern. All had disappeared and the lantern, striking the bottom of the stuffing-box as it moved on the rod, had caused the slamming sound.

At first it was a puzzle as to how the packing, particularly the metallic part of it, had escaped, but the mystery was solved when an examination showed that the clearance between the rod and the throat of the stuffing-box was a little more than ⅛ in. The packing had squeezed through the space into the cylinder, fragments of it being found subsequently in the ammonia condenser.

To prevent repetition of the trouble, a steel junk ring, lined with babbit metal and fitting the rod closely, was pressed to the bottom of the stuffing-box, as indicated in the accompanying sketch.

St. Louis, Mo. D. J. ALTIZER.

N.E.L.A. Pledges Faith in Future of the Industry

DESPITE A SOMEWHAT smaller attendance than has been usual the last few years, the 55th convention of the National Electric Light Association held at Atlantic City, June 4-10, was the same inspiring event that it has always been. Its business and technical sessions were well attended and the discussions were of a kind which gave courage and inspiration to those responsible for the policies and future progress of the industry. Although the electric power industry is in excellent condition compared to other branches of business, the meetings furnished renewed confidence in the soundness of the policies upon which the electric power industry is founded.

Opening the meeting formally on Tuesday morning, June 7, with his presidential address, J. F. Owens urged a better understanding of the industry by all who were engaged in it. Despite poor conditions, he pointed out that the industry as a whole is in excellent condition. Though the total number of domestic customers decreased from 20,330,000 to 20,276,000 during the year, a matter of only 0.3 per cent, the total domestic kilowatt hour consumption increased from 11,153,000,000 to 11,842,000,000—over six per cent. The total investment in plant during the same time increased 4.8 per cent, that is, from $12,400,000,000 to $13,000,000,000.

Throughout the entire week, an atmosphere of frankness and open-mindedness prevailed. There was no hesitancy on the part of those in charge to avoid delicate questions, or criticism. Regarding the question of rate schedules, Paul M. Downing, vice president of the Pacific Gas and Electric Co., made a plea for more uniformity and simplification of rate forms. To the average user of electric light and power, a proper and intelligent understanding of rates and rate schedules is an extremely mystifying problem. Technical terms bandied about freely by those in the industry, are meaningless to him. Because of this Mr. Downing proposed that the companies simplify the numerous and varied types of schedules now in use. The electrical and mechanical engineers, he points out, have done a splendid job of adopting standards of construction and operation and have met with almost universal acceptance by the industry. But what have the rate engineers accomplished in the way of agreeing even on the fundamentals of rate making. The answer to this question, Mr. Downing said, may be had by referring to any of the yearly rate books that have been issued from time to time by the N.E.L.A. The 1931 issue contains 688 pages of fine print and sets forth the rate schedules of all member companies. No two schedules are alike and every company seemingly has a number and variety of rates limited only by the ingenuity and imagination of their rate makers.

Popular Fallacies About Electrical Industry

Another excellent address was that of H. P. Liversidge of the Philadelphia Electric Co. He listed a number of fallacies in regard to power generation and transmission which prevail. These misconceptions or fancies he pointed out, are of considerable importance to all of us for this reason: What the public knows, or believes it knows of the industry, in the last analysis, fixes its attitude toward the industry, and that attitude has an important bearing on future progress.

Although there were many such fallacies, Mr. Liversidge said there were five to which he wished to direct attention in particular. These five are:

The exaggerated idea that electric energy can be transmitted great distances with economic justification.

The erroneous belief that because local electric systems exist side by side, complementing and supplementing each other, wherever their lines touch, they, as a group, form a single magnified network.

The notion that natural water power, if fully developed, would supply a very important part of the total demand for electrical energy. This is particularly fallacious in the industrial East.

The theory of mouth-of-mine generation of electricity, which fails to give proper weight to all the factors involved.

The groundless fear of great extension of interstate transmission lines so vast and complicated as to form almost an entangling web endangering, throttling, if you please, the very life and progress of our nation.

"Not one of these statements," said Mr. Liversidge, "has a basis in fact, either in theory or practice. I know this and so do you. Yet the public we serve, whose future is so closely interrelated with ours, bases its decisions and ofttimes its actions, on these fanciful ideas."

In calling attention to these fallacies, Mr. Liversidge then went on to describe briefly and concisely the correct economic principles of the generation and distribution of electricity.

In an address on the subject, "The Light and Power Industry and the Public Welfare," Floyd L. Carlisle, Chairman of the Board, Consolidated Gas Co. of New York and Niagara Hudson Power Corporation, urged that the National Electric Light Association defend its good name by taking direct diciplinary action against any utility whose leaders jeopardized the standing of the entire industry by indulging in unsafe and unsound practices.

Need for Continued Research

At both the general sessions, as well as at the technical sessions, several papers were presented which indicated the trend in regard to technical progress of the industry. Chief among these were papers by Arthur E. Silver, electrical engineer with the Electric Bond and Share Co., and Charles F. Kettering, vice president of the General Motors Corp. Mr. Kettering of course, spoke as an outsider, but as he pointed out, the industry which he represented also had an electrical phase. This industry, the automotive industry, operated some 25 million generating stations. Of course they were small. Only about 100 watts apiece. But combined, they involved two and a half million kilowatts of installed capacity.

Mr. Kettering stressed the necessity for research as a means of avoiding economical and technical stagnation, and pointed out the advisability of sometimes submitting problems to individuals who are not too closely connected to the industry itself. He cited many instances where men working in particular fields were unable to advance the progress in those fields, when men from different fields confronted with the same problems, managed to solve them successfully.

At the engineering session, papers were also presented by John C. Parker, president of the Brooklyn Edison Co., A. H. Kehoe, chairman of the Engineering National Section, and Samuel M. Kintner, vice president, Westinghouse Electric and Mfg. Co.

Mr. Kehoe presented a report on the work of the Engineering National Sections during the year and pointed out that the need for economies and improvements now was greater than ever before.

Mr. Parker, in referring to the future development of the industry, pointed out that the electric light and power industry stands firmly on a foundation of engineering and that in the further progress of the industry engineering should be applied to all its varied branches —executive and accounting as well as to the engineering department itself. He outlined the need for engineering thinking in the non-technical branches of the industry as well as in those divisions which have to do with the construction and operation of the power producing equipment itself.

Research was also the subject of Mr. Kintner's discussion. He termed research the "white hope of our industry." He showed that the central station industry development is not complete and that a thorough cooperative effort between the operators and the manufacturers as well as the consumers is necessary to secure the potential advantages that are to be had.

The few papers referred to here merely represent the high lights of the convention's activities. There were many others, all of which dealt with important phases of the industry and which would serve to inspire the members present with new courage to go on.

George B. Cortelyou, Next President

The meeting closed on Friday, June 10, with a report of the Nominating Committee for the elective offices for the administrative year, July 1, 1932 to June 30, 1933.

For President, the Committee nominated George B. Cortelyou, of the New York Edison Co., New York. For Treasurer, they renominated Edward Reynolds, Jr., of the Columbia Gas & Electric Co., Oklahoma City, Okla., who has served the association in that capacity during the past year. For Member-at-Large of the National Executive Committee, J. F. Owens, ex-officio, Oklahoma Gas & Electric Co., Oklahoma City, Okla., for one year. Representatives of Class A member companies for three years: E. W. Lloyd, Commonwealth Edison Co., Chicago, Ill., and P. S. Young, Public Service Electric & Gas Co., Newark, N. J . Representative of Class D member companies for three years: C. E. Cullinan, Graybar Electric Co., Inc., New York, N. Y. Representatives of Class F member companies for one year:

C. L. Collens, Reliance Electric & Manufacturing Co., Cleveland, Ohio. Earl N. Peak, Marshall Electric Co., Marshalltown, Iowa.

Representatives of Class A and Class D companies, terms expiring June 30, 1933:

D. C. Barnes, Engineers Public Service Co., New York, N. Y.

H. P. Liversidge, Philadelphia Electric Co., Philadelphia, Pa.

Charles W. Appleton, General Electric Co., New York, N. Y.

Representatives of Class A and Class D companies, terms expiring June 30, 1934:

Alex D. Bailey, Commonwealth Edison Co., Chicago, Ill.

John P. Coghlan, Pacific Gas and Electric Co., San Francisco, Cal.

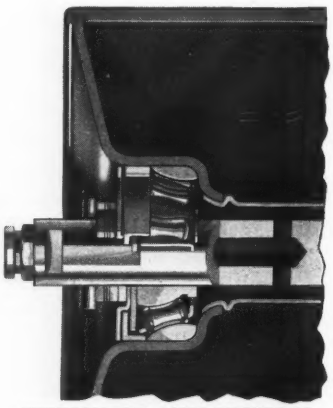
F. A. Merrick, Westinghouse Electric & Manufacturing Co., East Pittsburgh, Pa.

New Equipment

Anti-Friction Conveyor Carrier

THIS NEW conveyor carrier, announced by the Barber-Greene Co., has roller bearings which are self-aligning and take thrust as well as radial load.

Each size carrier has but one size roller unit, making these units and component parts interchangeable, the Barber-Greene carrier being made to interchange with



SECTION OF ANTI-FRICTION CARRIER ROLL.

any standard carriers for making replacements.

Of seamless tubing 9 gage metal, the roller is 5½ in. diam. with the ends of pressed steel having the outer roller race inserted under pressure. The inner tube is 1⅛ in. diam. with a shoulder at each end.

The spindle is ¾ in. diam., of cold rolled steel, drilled and tapped on each end for grease and Alemite, slotted to fit in the end brackets and provided with two flats to lock the grease-seal washers. It is also drilled and reamed at each end for taper pins. Bearings are held in place by two labyrinth-seal washers, shimmed to keep bearings tight, with three collar spaces between the bearing race and the taper pin. In case of wear on the bearings or that the bearings need to be tightened, the taper pin on one side can be removed, the necessary shim inserted and the taper pin driven in again.

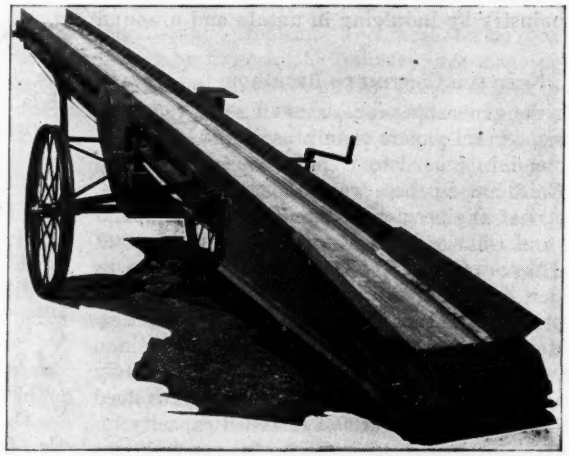
Grease fills the bearings as well as the labyrinth seals, thus keeping out dust and grit. The outer grease seal is pressed into the ends and revolves with the roller.

With factor of safety of 4½, each roller can carry load of 200 lb. or the entire carrier a load of 600 lb. Each roller is supported by two pressed steel brackets which are bolted to a channel base, three rollers being used on a carrier.

Portable Belt Conveyor

THIS NEW Fairfield Engineering Co. conveyor is built in lengths of 20, 25 and 30 ft., with 48-in. carriage wheels mounted on roller bearings. The rubber belt is 18 in. wide running on ball-bearing idlers, which are closely spaced and equipped with pressure lubrication fittings and an 8-in. lagged head pulley.

At the foot end a steel plate receiving hopper is equipped with replaceable rubber wear strips. Steel skirt plates for the full length provide a carrying trough 6 in. deep. The return belt is protected against falling material by a steel plate formed in an inverted V shape and running full length of the conveyor Discharge height is adjusted by a machined worm winch of the self-locking type mounted on side of conveyor frame. Power is furnished by a 3-hp. ball-bearing electric motor or a 4½-hp. air-cooled gasoline engine and transmitted to the head-shaft through steel roller chains and machined sprockets, including idler sprockets and automatic tension spring take-up.



FAIRFIELD TROUGHED CONVEYOR

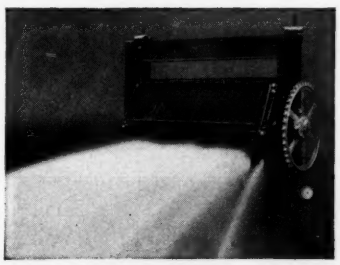
New Steel Flooring

DEVELOPMENT of a new steel flooring after long scientific investigation has been announced by Mellon Institute of Industrial Research, Pittsburgh, Pa. This flooring consists of slabs, 24 in. wide and up to 12 ft. 5 in. in length at present, that are fabricated by preforming two steel sheets and subsequently welding them together in the plane above the neutral axis. A cross-section taken through the width of a completed unit shows four keystone-shaped cells, all connected together near the neutral axis. These four ducts, which constitute each unit, are spaced at 6-in. intervals and connect directly, when installed, with the corresponding ducts of the adjacent section of floor slab, thus giving a floor efficient as a load-carrying member, also a multiple floor-duct system for handling all types of electrical lines. Such a grouping of parallel cells with 6-in. spacing is claimed to permit, at any time, the installation of electrical outlets within a radius of 3 in. from the exact location required, thus providing permanent electrical flexibility and precluding electrical obsolescence.

It is said that the keystone slab can be installed with ease and rapidity; that it can be bolted, clipped, or welded into place across the structural member, affording a working floor for the various trades. This floor is fire-safe; it is adaptable to appropriate finishes and to suspended ceilings and service piping, and has a low weight per square foot.

Spray Cleaning Nozzle

CHAIN BELT CO., Milwaukee, offers a novel product for removing debris from intake screens, sluicing ashes in power plants, removing scale from steel sheets in rolling mills and even watering grass. This is a die-cast aluminum spray nozzle developed originally for cleaning traveling water screens used for removing debris from condensing water in power plants, as shown in the illustration.



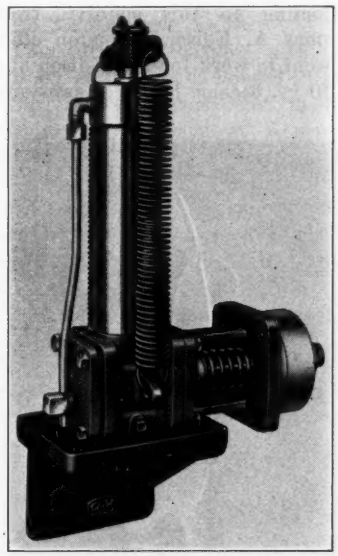
REX SPRAY NOZZLE

To be most effective for this sort of work, the design of the nozzle was required to be non-clogging, yet economical of water, apparently conflicting requirements because, to be non-clogging, there must be large, free openings, which would indicate large water consumption. Through the medium of a powerful flat or sheet spray, secured by having a round stream hit a curved deflector plate with retaining sides, the problem was solved, giving a flat spray of mist, all the water powerfully directed toward the material to be cleaned, yet keeping water consumption low.

Midget Boiler Regulator

THIS NEW regulator which the Ruggles-Klingemann Mfg. Co. of Salem, Mass., has developed for boilers operating on 15 lb. or less, is actuated by water pressure and will control damper adjustment, or both damper and fuel feed, where automatic stokers are used, within a variation of ¼ lb. plus or minus of any pressure setting ranging from 1 to 15 lb.

Automatic control of low pressure heating boilers depends on the degree of incremental control over the air supply passing through the boiler furnace, as excess air causes inefficient combustion from lowered



R-K REGULATOR

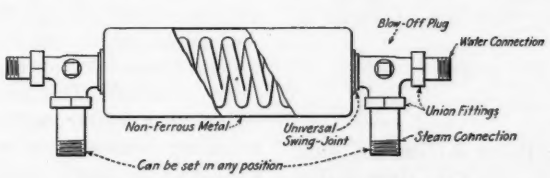
furnace temperature. On the other hand, deficiency of air supply results in the escape of unburned gases. The regulator is designed to avoid both undesirable conditions.

Rustless Water Heater

IN THE ERSKINE heater, as shown by the illustration, a helical coil of rustless metal, tested to 1200 lb. pressure, carries the water and is surrounded by a drum of heavy copper, tested to 150 lb. pressure. Universal swing joints at the ends permit taking off steam connections in any direction while union fittings on all connections allow ready removal for cleaning. It is possible, of course, to reverse the action so as to pass steam through the coil and water through the drum, in case high-pressure steam is to be used, or high-temperature water from a boiler may be used to heat the house supply to lower temperature.

The Erskine heater is adaptable for use in combination with gas-heated storage tanks, with hot-water, vapor or steam heating systems, or for exhaust or live steam, draining the heater by a trap.

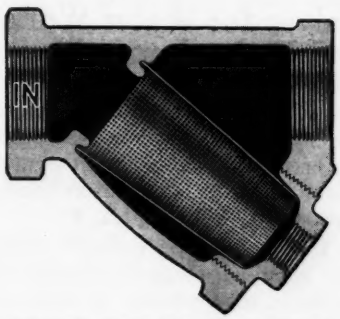
This heater is made by Erskine Copper Radiator Corpn., New York, N. Y.



ERSKINE RUSTLESS WATER HEATER

Fre-Floor Strainer

FOR USE in vertical or horizontal pipe runs this new strainer made by Fisher Governor Co., Marshalltown, Iowa, is designed with large screen areas having openings 1/64 or 1/32 in. for gases or liquids, and large blow-off area through the Y connection for quick, thorough cleaning. It is designed for pressures to 250 lb. and



FISHER TYPE 260 STEEL BODY STRAINER

temperatures to 500 deg. F.; for corrosive fluids, specially constructed strainer sieves are furnished. The illustration shows the semi-steel body, cast bronze bodies of similar construction being also included in the 260-Y series.

FOR UNLOADING loose bulk material from hopper bottom cars, Fairfield Engineering Co., Marion, Ohio, is offering a new portable, troughed belt feeder, 18 in. wide by 14 ft. long, powered by a 3-hp. motor or a 4½-hp. air-cooled gasoline engine.

Two New Westinghouse Welders

NEW 300 AND 400 amp. gas engine driven FlexArc welders have recently been announced by the Westinghouse Electric and Manufacturing Company. These new welders embody the following distinctive features: full canopy protection from weather, accessible controls, dependable power and transformer type reactance to prevent current surges and electrode sticking.

Standard units are equipped with large 6-inch rim steel tired wheels. Smaller shop type wheels can be furnished when desired. Also pneumatic and solid rubber tired wheels can be supplied.

Oversize exciters can be furnished to operate small portable tools, such as drills, grinders, buffers, lights, etc.

Valves for Water Works and Hydroelectric Plants

GROUP of valves especially designed for the field of water works and hydroelectric power generation has been added to its line by Southwark Division of Baldwin-Southwark Corp., Philadelphia, Pa.

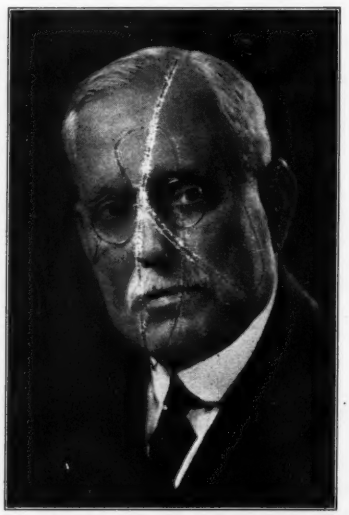
Larner-Johnson, internal cylinder, balanced plunger principle is employed in the design of many of these valves, which includes slow-closing check valves having an adjustable rate of closure, pressure regulators designed to function without oscillation or "chugging," surge suppressors said to involve an entirely new principle of operation, altitude valves, automatic air valves, throttling valves and automatic gate valves. They are available in all sizes.

READING-PRATT & CADY CO., INC., is offering ¾ and 1-in. globe valves, precision turned from high grade carbon steel, as an addition to its regular line of bar stock valves. They have stainless steel, slip-on renewable discs and screw-in seats, also stems designed and treated for temperature service. All other parts are Parkerized inside and out. Smaller size carbon steel valves have integral seats and discs. The working pressures are 4000 lb. at 150 deg. F., 600 lb. at 500 deg. F.

Samuel Insull Retires

BECAUSE OF ill health, due to the strain of developments during the last few months, Samuel Insull has resigned as chairman of the boards of Commonwealth-Edison, Peoples Gas Light and Coke and Public Service of Northern Illinois Cos. He also has withdrawn as a receiver of Middle West Utilities Co.

Coming to this country from Thomas A. Edison's London office he went to work for Mr. Edison and in 10 yr. became his chief assistant,



Wm. L. Koehne, photo

helping to organize companies to use the Edison inventions. Progress made him general manager of one of the Edison plants in Schenectady, then second vice-president of Edison General Electric Co. in 1889 and of General Electric Co. in 1892.

Coming to Chicago as president of Chicago Edison Co., he arranged a merger of all Chicago electric generating companies into the Commonwealth-Edison Co. of which he became president. This accomplished, visioning a better service to surrounding communities he gathered a number of small companies into the Public Service Co. of Northern Illinois, which he headed. Expansion followed into the rest of Illinois, Indiana and Wisconsin and, by a later conception into all parts of the country by organization of Middle West Utilities Co. to link up small companies through a holding corporation.

An interim activity was the rejuvenation of Peoples Gas Light and Coke Co., which, in 1918, was in need of help. Securing the aid of eastern capital Mr. Insull put that company on its feet so successfully that in a few years it was able to take over a new gas plant that had been built to supply gas to it.

Expansion of interests of Middle West Utilities Co. into the east, south and central west has involved large financing and the formation of Insull Utilities Investment Co. and Insull and Son for that purpose. At its maximum the expansion extended from Maine to western Texas and from No. Dakota to Florida. What will be the outcome of settlement by the receivers is of course uncertain but the "Chicago Pool of Power" will unquestionably remain as a monument to Mr. Insull's genius for organization of utility systems.

James Simpson Heads Chicago Utility Co.s

PRESIDENT OF Marshall Field & Co. since 1923 and chairman of the board since 1930, Mr. Simpson has been closely associated with the Commonwealth Edison Co. as a member of the board of directors for many years and for the last 3

Matzene Photo

mo. as a member of the executive committee. He now becomes chairman of the board of Commonwealth-Edison, Public Service of Northern Illinois and Peoples Gas Light and Coke Cos. as a means of coordinating their financial management. Samuel Insull, Jr., will remain as vice-chairman of the companies and there will be no change in the executive and operating organizations.

Starting as a clerk in 1891 at $6 a week, Mr. Simpson worked his way upward with Marshall Field & Co. to chairman of the board. He has been prominent in civic and financial affairs in Chicago, particularly as chairman of the Chicago Plan Commission, as a director of the Federal Reserve Bank and as trustee of the Field Museum. During the war, he was head of the Red Cross work in Chicago, assisting later in the work of that organization in France. His efforts were responsible for the building of the Merchandise Mart and other extensions of the Field interests.

Plans for leisure to travel are interrupted by his new activities to which he was summoned while in India, the return trip being made by airplanes and fast steamer in 14 days. His time will be devoted to the interests of the utility properties as he is giving up his official connection with Marshall Field & Co. in order to serve the interests of the city in guiding the affairs of its great light and power companies.

Kearny Station Starts New 75,000-Kw. Unit

ON JUNE 15 a 75,000-kw. turbine generator, the largest electric power generating unit in New Jersey, was put into preliminary operation by Public Service Electric & Gas Co. at its Kearny Generating Station. The new unit will increase the capacity of Kearny Station from 214,500 to 289,500 kw.

This turbine generator with its auxiliary equipment is housed in an extension, recently completed, to the existing turbine room at Kearny. Because of recent advancement made in turbine generator designs the new unit will occupy no more space than other generating units at Kearny which have considerably less capacity.

To provide for the additional steam needed to operate the new turbine, important improvements have been made to 12 of the Kearny station boilers during the past year. The firebrick walls of each boiler have been partially replaced, and the rear walls wholly replaced by water tube walls. In this way the boilers have been made to operate at higher capacities and thus generate the additional quantities of steam needed for operation of the 75,000-kw. machine. When operating under full load the turbine will require 780,000 lb. of steam per hour.

Another feature of the new equipment installed at Kearny is the huge welded steel condenser used with the new turbine generator. Weighing more than 16½ t. and containing 11,900 brass tubes, each 24 ft. long, the condenser is the largest of its kind ever built. When in full operation, water will be pumped through it at the rate of approximately 105,000 g.p.m.

FOR USE with temperature and pressure controllers, The Foxboro Co., Foxboro, Mass., has designed a pneumatic switch which makes possible the use of air-operated controllers on electrically-driven equipment.

News From the Field

FISHER GOVERNOR Co. has recently established two new exclusive representatives, the Grinnell Co., 240 Seventh Ave., South, Minneapolis, Minnesota, and the Steam Plant Equipment Co., 1012 N. Third St., Milwaukee, Wisconsin.

H. V. Schiefer, formerly with the R. H. Beaumont Co., is now associated with The C. O. Bartlett & Snow Co. of Cleveland, Ohio. Mr. Schiefer will make his headquarters at the Company's main offices in Cleveland, Ohio.

CONTRACT for the construction of the addition to the municipal power plant for the Board of Public Works, Fort Wayne, Indiana, was awarded to Max Irmscher & Sons of Fort Wayne, Indiana, for $123,558.00. The Froelich & Emery Engineering Co., Toledo, Ohio, are engineers.

ERNEST E. LEE Co., 115 So. Dearborn St., Chicago, has been appointed sales representative for the Elgin Softener Corp., Elgin, Ill., to handle Chicago and northern Illinois.

JOHN J. O'BRIEN, president, announces that at a meeting of the board of directors of the Standard Gas and Electric Co., Henry C. Cummins was elected a member of the executive committee to succeed Halford Erickson, deceased.

G. G. VAN TUYL, 3 Cardiff Park, Rochester, N. Y., who for a number of years was associated with the sales department of Foster-Wheeler Co., has been appointed representative of Ross Heater & Mfg. Co., Inc., for Western, N. Y. Also Arno N. Dietze, formerly with Foster-Wheeler Co., has been appointed representative in Milwaukee with offices in the Security Bldg., and in Boston territory, Gustavo Preston Co.

SARCO Co., Inc., 183 Madison Ave., New York announces its appointment as exclusive distributor in Greater New York of valves for radiators and industrial purposes manufactured by Marsh Valve Co. of Dunkirk, N. Y. in place of Appleton and Liptrott, Inc.

GEORGE W. PAGE, vice president and a director of the W. A. Jones Foundry and Machine Co., Chicago, Illinois, died at his home on May 29. He was 51 yr. old and had been with the company for 33 yr., beginning his career as a shipping clerk in 1899.

E. H. NEGLEY, for 27 yr. associated with the public utility business, is now district manager for the Central Illinois Public Service Corp., with headquarters in Quincy, Ill. He is widely known in the district, having been manager at the company's Canton, Ill. branch the past few years.

THE IOWA RAILWAY and Light Corp. has certified to the secretary of state in Iowa to change of its corporate name to the Iowa Electric Light and Power Co., as Sutherland Dows, vice president, announced June 1. "The change is one of name only," he stated, "and does not in any way affect the capitalization, ownership or management of the company. Over a period of years the business of the company has gradually changed until the railroad interests now represent but a small per cent of the total business." Railroad holdings of the company are now only Cedar Rapids and Iowa City lines and subsidiary branches and a mile and a half line in Boone, Iowa.

WILLIAMS Patent Crusher & Pulverizer Co., of St. Louis, announces the following district representative appointments: Edwin D. Cassel, 1836 Euclid Ave., Cleveland, for Northern Ohio; Howard D. McCullough, 304 Coleman Bldg., Louisville, Ky., for the State of Kentucky; Starr Equipment Co., 1124 Park Bldg., Pittsburgh, for the Pittsburgh territory.

OFFICERS elected by the American Society for Testing Materials at its recent Atlantic City meeting are: President, Cloyd M. Chapman, consulting engineer, New York; vice-president, William H. Bassett, metallurgical manager, American Brass Co., Waterbury, Conn.; executive committee members, H. A. Gardner, chemical engineer, Inst. of Paint and Varnish Research, Washington, D. C.; J. O. Leech, asst. metallurgical engineer, Carnegie Steel Co., Pittsburgh, J. T. Mackenzie, chief chemist, American Cast Iron Pipe Co., Birmingham, J. C. Ramage, engineer of tests, So. Ry. System, Alexandria, Va., H. S. Vassar, laboratory engineer, Pub. Serv. Elec. & Gas Co., Irvington, N. J.

GEORGE J. KADEL, president of Elliott Service Co., Inc., announces the opening of a branch office at 729 Seward St., Detroit, as headquarters for Michigan, Indiana, Illinois and Iowa. A. M. Bennet will be in charge of the service which includes accident prevention, waste eliminaton, foremanship development and news picture advertising.

BABCOCK & WILCOX Co. has been granted the exclusive rights in the United States and Canada for manufacture of the automatic pressure circulating and indirect heating system of sulphite cooking developed by the Kimberly-Clark Corp., which is patented and is being successfully used in six digesters in the Kimberly Mill, Kimberly, Wisconsin. Manu-

facture of this equipment conforms with the company's policy of building special process equipment such as welded pressure parts and corrosion-resisting alloy equipment. All alloy material used will be produced under the supervision of metallurgists of the company and of an analysis successfully developed for sulphite service. Fabricated parts will be made in the Barberton Works where a modern foundry, completely equipped with high-frequency induction melting-furnaces, is operated exclusively for alloy materials.

POOLE Foundry and Machine Co., of Baltimore, Md. has appointed the Ladd Equipment Co., First National Bank Building, Pittsburgh, as its district representative in Western Pennsylvania, West Virginia and Eastern Ohio.

FEDERAL Light & Traction Co., has removed its offices to 70 Pine St., New York City.

POND CREEK Pocahontas Coal Corp., Bartley, W. Va., recently installed what the Link Belt Co., believes to be the largest conveyor belt ever shippped in a single piece. It is of 8-ply construction, has a 3/16-in. top cover, and measures 42-in. wide by 13/16-in. thick by 1615-ft. long. The belt weighs 28,370-lb., is carried on anti-friction idlers and brings the coal from the mine slope to the shakers of the new tipple and washery.

A. F. DICKERSON, engineer of the Illuminating Engineering Laboratory of the General Electric Co., has been named manager of lighting sales and the illuminating laboratory. The activities of the present commercial lighting section in the general office and those of the illuminating engineering laboratory have been consolidated in order better to coordinate the selling and engineering activities. This new section will be a part of the lighting and cable division of the Central Station Department, under the supervision of F. H. Winkley, manager of that division.

W. D'Arcy Ryan, formerly director of the laboratory, has been named consulting engineer of the section.

ON JULY 25 the 75th anniversary of Frank J. Sprague will be honored by a meeting at 29 W. 39th St., New York, at 8 p. m. Tribute will be paid to Mr. Sprague's achievements in development of electric transportation, motors, railways and elevators, addresses to be given by Dr. John H. Finlay, Frank Hedley and Rear Admiral S. S. Robison, retired.

CASE HARDENING SERVICE Co., Cleveland, Ohio, has been appointed representative of Ray Burner Co. for Cleveland and vicinity, with H. W. Kaiser in charge of engineering and sales and J. M. Marty to handle installation and service.

FOSTER WHEELER CORP. has appointed Consolidated Steel Corp., Ltd., exclusive sales and manufacturing representatives for its products on the Pacific Coast, including the states of California, Washington, Oregon, Nevada, Utah, Arizona and New Mexico. These sales were previously handled by district offices in San Francisco and Los Angeles under the direction of C. L. Froding of San Francisco, assisted by R. D. Spear in San Francisco, M. J. Gavin in Los Angeles. Messrs. Froding and Spear are now located in the San Francisco office of Consolidated Steel and Mr. Gavin is in the main office of Consolidated Steel in Los Angeles.

Foster Wheeler will continue to maintain a complete engineering organization in Los Angeles under the direction of W. L. Rifenberick, chief engineer of the gasoline department in California with offices in the Petroleum Securities Building.

In addition to handling the sales of Foster Wheeler equipment, Consolidated Steel will manufacture the major portion of such equipment installed in the Pacific Coast territory, thus bringing the manufacturer closer to the user.

For the Engineer's Library

RECENT TECHNOLOGICAL DEVELOPMENTS and the Municipally-Owned Power Plant. By Paul Jerome Raver. 86 pp. with tables and charts. 8 by 10 in. paper, 1932. Institute for Economic Research, Chicago, Ill. Price $1.50.

Containing probably the most complete data ever gathered on municipally owned plants, this book by tables, charts and analyses gives a picture of the development of such plants by location, size and type of prime mover. The author has endeavored to trace the effect of improvements and developments in generating equipment and in transmission systems on the rise and fall in numbers and size of plants, recognizing, at the same time, that other factors have had modifying influences. He presents conclusions reached as indications rather than as positive statements and refrains from predictions as to the future, although discussing probabilities.

Some interesting points brought out are that plants under 500 hp. have decreased rapidly since 1921; from 500 to 1000 hp. plants have about held their own; while for over 1000 hp. there has been steady increase in numbers since 1903, the most rapid rate of increase being in the range from 5000 to 25,000 hp. By regions and types of prime mover the steam-engine plant which has survived is in sizes above 1000 hp. in the region from the Mississippi River to the Rocky Mountain states; steam turbine plants which have survived are in sizes over 1000 hp. in all regions from the Rocky Mountains east; hydro-electric plants are over 1000 hp. which show survival in states east of the Mississippi and Ohio rivers; for oil engine plants, size required for survival has been 300 hp. for the regions from the Rockies to the Mississippi and north of the Ohio River, 500 hp. for south of the Ohio River and Pennsylvania, 1000 hp. for New England, New York and Pennsylvania; composite plants, combinations of hydro-electric, steam, and oil engine show survival in sizes over 1000 hp. from the Pacific coast east to the Mississippi and north of the Ohio River to Pennsylvania. The effect is here shown of remoteness of plants from transmission networks and unattractiveness of small loads to private capital for small plant operation.

Increase in installed capacity from 1922 to 1930 was largely by additions to existing plants and for the most part in a few plants. Of a total of 2038 plants, only 982 showed increase in capacity, over half the increase being confined to 56 plants. At the beginning of the 9-yr. period, total number of plants was 1871 and, at the end, 931, the large decrease being in the period from 1925-27 when the loss of 604 plants was recorded. From 1928-30 the rate of decrease was less, the net loss being 160 plants. During the 9-yr. period, large plants increased in number, those in size from 2000-5000 hp., from 51 to 105; from 5000-10,000 hp., from 11 to 43; from 10,000-25,000 hp., from 3 to 5; over 25,000 hp., from 6 to 13.

The book is a record of a well done research and analysis, well worth careful study by those interested in municipal plant problems.

INTERNATIONAL INQUIRY INTO COSTS OF LIVING. 200 pp. 6 by 9 in., paper. Twentieth Century Fund, Inc., New York; price, $2.

In the study of comparative costs of living and wages, for different countries, Detroit was taken as a standard and the $6 a day wage at the Ford plant as the basis, with typical budget for food, clothing, rent and other expenses. Costs were then compiled in 14 European cities for a like standard of living and the wages necessary to procure it. This was compared with actual wages as paid in those cities and results showed that increase in European wages of 10 to 165 per cent would be needed to enable the European workman to live on the same plane as the Detroit workman. The conclusion is that, in Detroit the value of workers' wages, measured in what they will buy is greater than for any of the European cities and far in excess for some. It is interesting to note that Barcelona, Spain, showed the lowest necessary expenditure but wages were found so low that a 144 per cent increase would be necessary to bring the Barcelonan standard of living up to that of Detroit. The reason for the Detroit standard was the original inquiry from Ford Motor Co., Ltd., as to cost of living in European countries with a view to establishing wages in its European plants based on scale of a living comparable to that enjoyed by its Detroit workers. The book gives full tables of values, discussion of costs of various items in each of the cities considered and prices for detail items of foods, fuel, clothing and household necessities.

It is a valuable contribution to our data as to living conditions, one of the best features being the details as to expenditures actually made for various purposes, amounts of food and clothing used and costs of each item.

REFRIGERATING DATA BOOK. Published by the American Society of Refrigerating Engineers, 37 West 39th Street, New York, N. Y. 426 pages. 6 by 9 in. flexible fabricoid. Price $3.50 prepaid in U. S.

Compiled and written by a committee of some 40 of the leading refrigerating engineers in the country, this is probably the only thoroughly complete and up-to-date book on the practical developments and application of refrigeration available. The 26 chapters are divided into six sections headed: fundamental data; principles; refrigerating machinery; insulation and containers; refrigerating equipment and applications. In the last section is covered air cooling and conditioning; cold storage plants; freezing of foods; ice plant design and solid CO_2. Conver-

sion tables, a glossary of refrigerating terms, A.S.R.E. Codes, 100 pp. of a condensed refrigerating equipment catalog and a list of members of the A.S.R.E. add to the general value of the volume. The book is more than a complete handbook; it is a concise library.

DIESEL ENGINES, vertical four-cycle direct injection type B are described and illustrated in a new bulletin S-500—B5A (superseding S-500—B5) issued by Worthington Pump & Machinery Corp., 2 Park Ave., New York. Type C engines are described in bulletin S-500—S5 and Types D and E in bulletins S-500—B7 and S4 respectively. The 17x25 engine is described in S-500—S6. Bulletin S-550—S1 describes Gas Engines, vertical four-cycle, type BG, there is a new folder on portable air compressors and the type D monobloc centrifugal pumping unit is described in bulletin W-321—S1A.

FALCON bare electric immersion heating units are described in Bulletin 270 just published by H. O. Swoboda, Inc., 3530 Forbes St., Pittsburgh, Pa.

UNDERGROUND Steam Construction Co., 75 Pitts St., Boston, Mass., a subsidiary of E. B. Badger & Sons Co., has just issued an attractively illustrated 16-page bulletin describing methods and equipment used in underground steam systems, illustrated by many photographs of the company's installations.

HIGH TORQUE in flow meters is the subject of a 32-page pamphlet issued by the Cochrane Corp., Philadelphia. The primary metering element of the pipe flow meter considered is a thin plate orifice or flow nozzle clamped between flanges in the pipe line, the pressures preceding and following the orifice being led through the flexible torsion tubes to the two limbs of a U-tube. The latter is suspended upon a knife edge so that, when the mercury seal in the U-tube is displaced from one limb to the other by any difference in pressure, the U-tube will tilt. The tilting is resisted by a metallic ribbon kept under tension by a weight and pressing against a cam, shaped so that the amount of tilt is proportional to the rate of flow. It is claimed that, due to the high torque afforded by the U-tube and also to the frictionless character of the suspension, as well as to the fact that the torsion tubes which take the place of the stuffing box have practically no hysteresis, there is little or no lag between the deflection of the manometer and the differential at the primary element. The U-tube moves a pointer which traverses a 40-in. scale having uniform divisions and at the same time actuates a pen inscribing upon a 12-in. diameter chart also having uniformly spaced divisions. A clock-driven integrator utilizes the deflection of the U-tube to totalize the flow without affecting the accuracy of deflection. A calibrating weight to be hung upon the balance is provided for verification of accuracy, which can be accomplished in a few minutes time whenever desired and without the trouble involved in testing by means of a water column.

REFRIGERATION as a new tool in industrial plants is demonstrated in a folder showing various applications, issued by Frick Co., Waynesboro, Pa.

IDEAL ELECTRIC & MFG. Co., Mansfield, Ohio, issues bulletin No. 210 giving details of the design characteristics, and construction of the Noel polyphase capacitor motor.

DUST COLLECTORS as made by the Blaw-Knox Co. of Pittsburgh are described in illustrated catalog No. 1391, which shows construction and principles of operation.

IN A NEW BULLETIN, No. 632, Esterline-Angus Co., Indianapolis, Ind., announces new designs of graphic meters with improved clocks, chart drives and cases.

SUPPLEMENTING its other lines of single-phase motors, Wagner Electric Corp., St. Louis, Mo., offers a line of capacitor motors, known as type RZH, of condenser - start, condenser - run, split - phase type, the condenser capacity being varied from start to run by means of a switch and an auto-transformer. They are described in Bulletin 167, Part 6.

LAGONDA MFG. Co., Springfield, Ohio, has published a new 24-page catalog, X-12, describing its general line of Lagonda tube cleaners, which covers the following types: Thrust-bearing water-driven; air or steam driven; various types of cutter heads, drill heads, wire brushes, universal joints; vibrator type for return tubular boilers; types for locomotive arch tubes, delivery pipes and syphons; for large tubes or pipes and for small tubes in condensers and evaporators; lubricating devices; cleaner feeding device for feeding the cleaner into curved tube boilers; heavy-duty straight tube cleaner; operating hose and accessories.

The same company announces Bulletin X-13 covering new Series 450 cleaners for oil stills, incorporating refinements and improvements in motor and heads for greater power and speed with saving in cost of cleaning tubes. Copies may be had upon request.

WING-SCRUPLEX safety ventilating fans are described in detail in Bulletin F-5 issued by L. J. Wing Mfg. Co., 154 W. 14th St., New York, N. Y. Its application for unit heaters, process heaters, cooling systems, also tables of capacities and dimensions are given.

TRANSFORMERS is the subject of a new 54-page, loose-leaf bulletin No. 172 issued by the Wagner Electric Corp., 6400 Plymouth Ave., St. Louis, Mo. It covers all types of distribution transformers, construction features being illustrated and described in detail.

TWO BULLETINS are received from the Viking Pump Co., Cedar Falls, Ia.; VS101 describes sanitary pumps and various types of drives, with new tables of capacities and dimensions; VS402 is on twin outfits with relief valves on the head.

FORNEY gas and oil burners are detailed and some installations shown in a bulletin from Forney Combustion Engineering Co., Dallas, Texas. A new type, B.L. is rectangular in shape, for low-pressure gas with multiple jets and louvre type air dampers.

DEARBORN Concentration Hydrometer is described and illustrated in a folder received from Dearborn Chemical Co., 310 So. Michigan Ave., Chicago, Ill.

AMERICAN flexible coupling is illustrated in detail, its action described and sizes, capacities and prices given in a new 16-p. catalog, Bulletin 102, issued by American Flexible Coupling Co., Erie, Pa.

STRONG steam traps of the 70 and 20 series of inverted bucket type and the 30 series with open bucket are described and illustrated in Bulletin No. 59 of the Strong, Carlisle & Hammond Co., 1392 W. 3rd St., Cleveland, Ohio.

NOFUZE LOAD CENTERS, panelboards and switchboards; meter services; outdoor and indoor commercial and industrial type circuit breakers, all using the "Deion" principle of arc extinction, which enables the elimination of fuses and knife switches for circuit protection and control, are described in a new catalog published by the Westinghouse Electric and Manufacturing Company, East Pittsburgh, Pa. This 76-page illustrated publication, is identified as catalog 2246.

SOFT WATER for Your Home is the subject of a leaflet issued by the Cochrane Corp., Philadelphia, in which is described a softener for converting hard water containing lime, magnesium and other minerals in solution into soft water for use for domestic and plant purposes. A filter bed reduces lime and magnesium and when the filtering material becomes exhausted, it is regenrated by back-washing with a solution of ordinary table salt.

DEVELOPMENT of a Direct Contact Heater is the title of the research series Bulletin No. 38 published by the Engineering Experiment Station of Purdue University, Lafayette, Ind. This bulletin describes in detail a number of heater designs and burner arrangements for burning gas fuel in direct contact with water. As the result of extensive experiments it was concluded that this method of heating is practical and gives high thermal efficiency. The products of combustion have their temperature reduced to practically that of the water being heated.

DEAN Universal tube cleaners are described in detail, the principles of action explained and method of operation clearly illustrated in an attractive 20-p. catalog issued by the William B. Pierce Co., 45 No. Division St., Buffalo, N. Y.

EVERLASTING valves as made by the Everlasting Valve Co., 1 Montgomery St., Jersey City, N. J., are shown in detail with capacities, dimensions and price list in Bulletin E-46 issued by the company.

MECHANICAL Fuel-Oil Burning Systems is the title of a 20-p. bulletin, 16-A, issued by the Schutte & Koerting Co., describing and illustrating the action and details of its Type C burners and showing combustion oil and gas arrangement with various applications. Accessories, including pumps, heaters, strainers and valves are also covered.

NICKEL STEEL TOPICS. Issued bimonthly by International Nickel Co., Inc., is devoted exclusively to nickel alloy steels, containing technical, semi-technical and news articles dealing with the production, treatment and uses of these steels in the rolled, forged and cast form, also editorials, question and answer section and other special features.

FLOAT Valve Controls is the title of Bulletin No. 201-A of the Frick Co., Waynesboro, Pa. It shows the action and application of this system either to hold a predetermined level in the evaporator continuously, or to keep the receiver continuously drained, holding all liquid in the evaporator coils. Valves are for liquid lines from ½ in. to 2 in.

CAPACITIES and dimensions of Convectofin built-in heating elements are given in a circular sent out by Commodore Heaters Corp. 11 W. 42nd St., New York, N. Y.

Power Plant Construction News

Ark., Fort Smith—Board of Water Commissioners, Fort Smith, W. H. Vaughn, head, plans installation of pumping machinery and auxiliary equipment in connection with expansion and improvement program at municipal waterworks, for which fund of over $100,000 will be arranged.

B. C., Vancouver—Shell Oil Co. of British Columbia, Vancouver, plans construction of a boiler plant, pumping station and other mechanical units at proposed new oil refinery on 80-acre tract of land near city, recently acquired, with installation of electric and steam power equipment for refining operations. Entire project will cost close to $1,000,000. Company is affiliated with Shell Union Oil Corporation, 80 Broad Street, New York.

Calif., Alta Loma—Upland Sanitarium Corporation, Dr. Frederick C. Hager, 1601 North Wilcox Avenue, Los Angeles, secretary, plans installation of steam power plant in proposed new sanitarium at Alta Loma; also, water tank units, water-softening and filtration equipment. Entire project will cost about $250,000. Edward C. Taylor and Ellis W. Taylor, 803 West Third Street, Los Angeles, are architects.

Calif., Oceanside—City Council, Oceanside, is considering construction of a municipal electric light and power plant, using Diesel engine units. Estimates of cost will soon be made.

Calif., San Luis Obispo—Midland Counties Public Service Corporation, Fresno, Calif., plans extensions in transmission line in vicinity of San Luis Obispo, and construction of new power substation about 40 miles from that city, estimated to cost close to $65,000.

Colo., Denver—Board of Water Commissioners, City and County of Denver, 1509 Cleveland Place, has plans under way for a new one-story pumping plant on South University Boulevard, 40 x 105 ft., estimated to cost about $50,000, with equipment. Plans scheduled for completion in July. R. Ewing Stiffler, 816 Twelfth Street, is architect.

Ill., Hillsboro—City Council has plans under way for a municipal electric light and power plant, reported to cost about $200,000, with equipment. It is proposed to arrange bond issue in that amount at early date. Warren & VanPragg, Decatur, Ill., are consulting engineers.

Ind., Alexandria—City Council is having a survey made and report prepared by John W. Moore & Son, Indiana Pythian Building, Indianapolis, Ind., consulting engineers, for a proposed municipal electric light and power plant.

Ind., Indianapolis—Board of Park Commissioners, Anna Segar Memorial Building, Rhodius Park, is planning installation of new pumping equipment and auxiliaries, with capacity of 300 gal. per min., for service in Garfield Park.

Ind., Marion—Board of Public Works is planning installation of two centrifugal pumping units and auxiliary equipment at municipal pumping station. Bids will be asked at early date. John W. Moore & Co., Indiana Pythian Building, Indianapolis, Ind., are consulting engineers.

Iowa, Cedar Rapids—Central States Electric Co., Dows Building, Cedar Rapids, is considering installation of natural gas distributing system in Adair and Union Counties, including pipe lines, booster equipment, etc. Application for permission has been made.

Iowa, Davenport—Board of Education, J. E. Baumgartner, secretary, is planning installation of automatic stokers and accessories in boiler plants in number of public schools.

Iowa, Sumner—City Council is expected to ask bids early in July for proposed municipal electric light and power plant, estimated to cost close to $100,000, with equipment. H. L. Cory Co., Redick Tower Building, Omaha, Neb., is consulting engineer.

Kan., Kansas City—Dri-Ice Refrigeration & Service Co., care of R. S. McGuire, 1533 Grand Avenue, Kansas City, is considering construction of new dry ice-manufacturing plant on site at Nineteenth Street and Kansas Avenue, estimated to cost over $100,000, with equipment.

Kan., Wilmington—Commander-Larabee Corporation, Minneapolis, Minn., operating flour-milling plants, plans, installation of motors, conveyors and other electric power equipment in new grain elevator at Wilmington, with capacity of 1,000,000 bu., entire project estimated to cost over $200,000. Plans for unit have been approved.

Ky., Greenville—City Ice Co., Greenville, has plans for new one-story ice-manufacturing plant, estimated to cost close to $25,000, with equipment. Key & Langston, Murray, Ky., are architects.

Md., Baltimore—Community Ice Co., 6100 Belair Road, has taken out a permit for a one-story addition to ice-manufacturing plant, 30 x 35 ft., reported to cost about $24,000, with equipment. J. Lester Barr, 2648 Maryland Avenue, is engineer.

Mass., Gardner—Department of Mental Diseases, Commonwealth of Massachusetts, State House, Boston, has plans for steam power plant, 66 x 74 ft., at State Colony, Gardner, for central heating service, estimated to cost over $100,000, with equipment. Contract for general construction let to Proffit & White Construction Co., Fitchburg, Mass.

Mich., Detroit—Detroit Edison Co., 2000 Second Avenue, has completed plans for an addition to power substation on Lycaste Avenue, reported to cost over $65,000, with equipment. Company engineering department is in charge.

Minn., Duluth—Department of Public Works, Emil Gustafson, commissioner, is planning installation of pumping machinery and auxiliary equipment in proposed new chlorination plant for municipal waterworks. Entire cost about $200,000. Proposed to ask bids at early date.

Minn., Elk River—Village Council, W. F. Chadbourn, village clerk, is considering installation of a municipal electric light and power plant, reported to cost over $75,000 with equipment. Proposed to select engineer to prepare plans in near future.

N. H., Plymouth—Board of Trustees, Holderness School, has plans under way for a steam power plant for central heating service, in connection with new group of buildings on campus. Entire project is reported to cost about $550,000. J. Frederick Larson, Hanover, N. H., is architect.

N. J., Hoboken—Hinde & Dauch Paper Co., Sandusky, Ohio, manufacturer of corrugated paper boxes and containers, plans installation of electric power equipment in new plant on site recently acquired at Madison and Monroe Streets, Hoboken. Entire project will cost close to $200,000. Otto Randolph, Inc., 53 West Jackson Boulevard, Chicago, Ill., is consulting engineer.

N. J., Newark—Department of Public Affairs, City Hall, Jerome T. Congleton, mayor, director, will soon take bids for wire, wire supports and other electrical equipment for the new city railway system.

Que., Montreal—Shell Oil Co. of Canada, Ltd., Toronto, Ont., an interest of Shell Union Oil Corporation, 80 Broad Street, New York, plans construction of boiler plant, pumping station and other mechanical units at new oil refining plant in eastern part of Montreal, where tract of land is being acquired. Entire project will cost about $1,300,000.

Tenn., Memphis—Memphis Bonded Warehouse Co., Inc., 20 Adams Avenue, Ellis B. Anderson, president, plans installation of electric power and other mechanical equipment in proposed river and rail terminal on Wolf River, project to include a grain elevator of 1,000,000 bu. capacity, oil storage tanks of 4,000,000 gal. capacity and other units. Estimated cost over $800,000.

Texas, Austin—Board of Regents, University of Texas, Austin, has plans for an addition to power plant at institution, and proposes early construction. Cost reported over $65,000 with equipment.

Texas, Forth Worth—Marathon Oil Co., Fort Worth, affiliated with Ohio Oil Co., Findlay, Ohio, plans installation of steam and electric power equipment in connection with an expansion and improvement program at local oil refining plant, entire project reported to cost over $850,000.

Wash., Seattle—Board of Public Works, Seattle, has awarded general contract to Bayley Hipkins, Inc., Eitel Building, Seattle, for construction of power plant at Diablo and for other work in connection with municipal hydroelectric power development on Skagit River, at $1,747,705. Entire project will cost over $6,000,000, with transmission lines and power substations.

Wis., Combined Locks—Combined Locks Paper Co., plans installation of power equipment in three new plant units, reported to cost over $80,000. Work will begin at early date. W. K. Kolb is company engineer.

Wis., Sheboygan—City Council is planning installation of an elevated steel tank and tower in connection with extensions in municipal water system. Work will cost about $200,000. A bond issue is proposed. A. L. Boley is city engineer.